Name – Aditya Raj
Admission no. – U20CS100

Expt. No:	1	Diode Clipper Circuits
Date:	16/8/2021	

AIM: To implement various Diode clipper circuits and verify its performance using Multi - Sim simulator

SOFTWARE TOOLS / OTHER REQUIREMENTS:

1. Multisim Simulator/Circuit Simulator

THEORY:

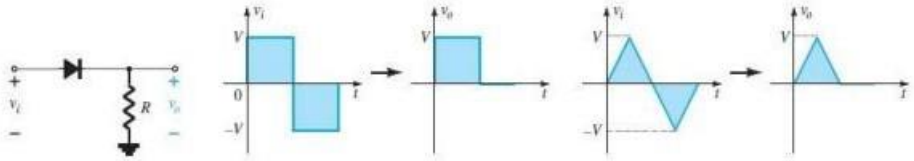
We know that when a diode is forward biased it allows current to pass through itself clamping the voltage across it to 0.7 volts (Practical Silicon Diode). While, when it is reverse biased, no current flows through it and the voltage across its terminals is unaffected, and this is the basic operation of the diode clipping circuit.

Clippers are networks that employ diodes to "clip" away a portion of an input signal without distorting the remaining part of the applied waveform.

There are two general categories of clippers: ***Series*** and ***Parallel***. The series configuration is defined as the one where the diode is in series with the load, whereas the parallel variety has the diode in a branch parallel to the load.

SERIES CONFIGRUATIONS

NEGATIVE CLIPPER :

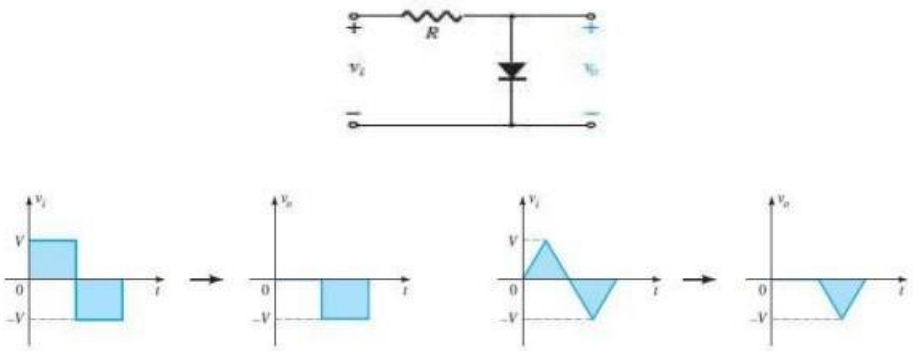


As shown above, when the positive half cycle appears, the diode being forward biased, acts as short circuit and allows the input voltage to appear across the load resistor. During the negative half cycle, the diode is reverse biased, acts as open circuit and hence we see that there is no connection between the output and input node, thereby the output voltage level remains at zero. Since the negative cycle of the input is getting clipped-off, the configuration in the above circuit is known as negative clipper.

Like-wise when the polarity of the diode is reversed, we can clipper-off the positive half of the input cycle. In this case, during the positive half cycle, the diode remains reverse biased thereby disconnecting the output node from input node and the output voltage level remains at zero. But when the negative half cycle appears, the diode gets forward biased and allows the entire input to appear across the output load resistance.

SHUNT CONFIGRUATIONS

SHUNT POSITIVE CLIPPER



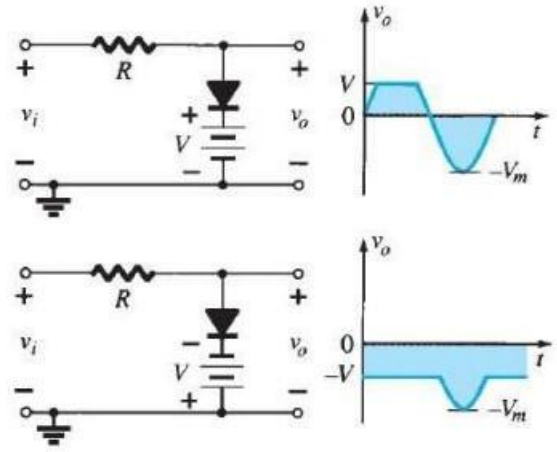
As shown above, when the positive half cycle appears, the diode being forward biased, acts as short circuit and thus the output voltage remains at zero level. During the negative half

cycle, the diode is reverse biased, acts as open circuit and hence we see that the output node comes into direct contact with the input node, thereby the output follows the input. Since the positive cycle of the input is getting clipped-off, the configuration in the above circuit is known as shunt positive clipper.

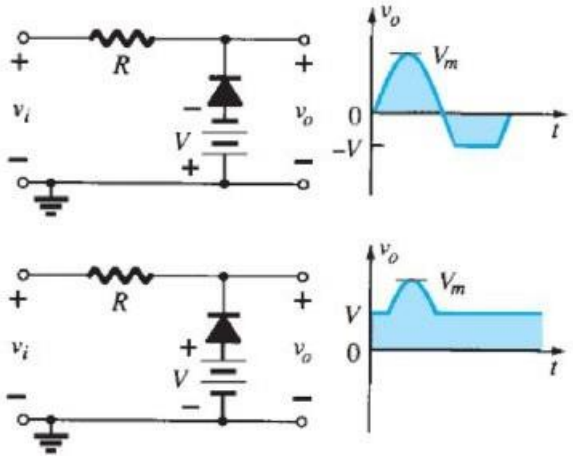
Likewiseif the polarity of the diode is reversed; we can clipp-off the negative half of the input cycle. In this case, during the positive half cycle, the diode remains reverse biased thereby connecting the output node with input node and the output voltage follows the input. But when the negative half cycle appears, the diode gets forward biased creating a short across the output nodes resulting into a zero voltage at the output. The level will be 0.7 if a silicon diode is considered instead of an non-ideal diode.

FEW SHUNT DIODE CLIPPER CONFIGURATIONS

POSITIVE

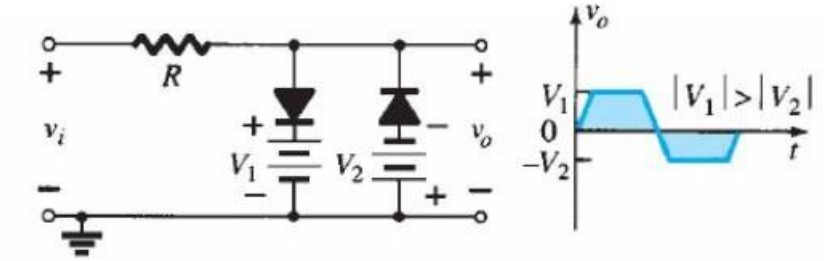


NEGATIVE



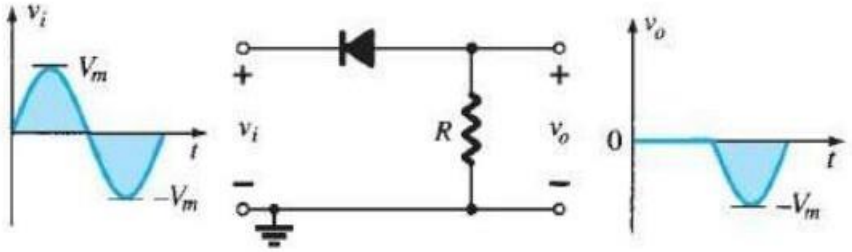
TWO LEVEL CLIPPERS

These circuits employ clipping in both the directions (Postivie as well as Negative Half Cycles) as shown in figure below:

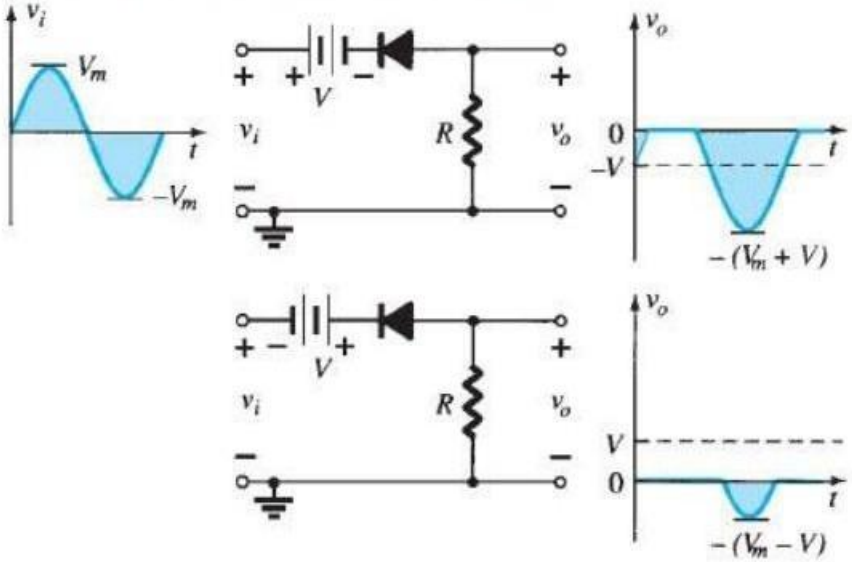


FEW SERIES DIODE CLIPPER CONFIGURATIONS

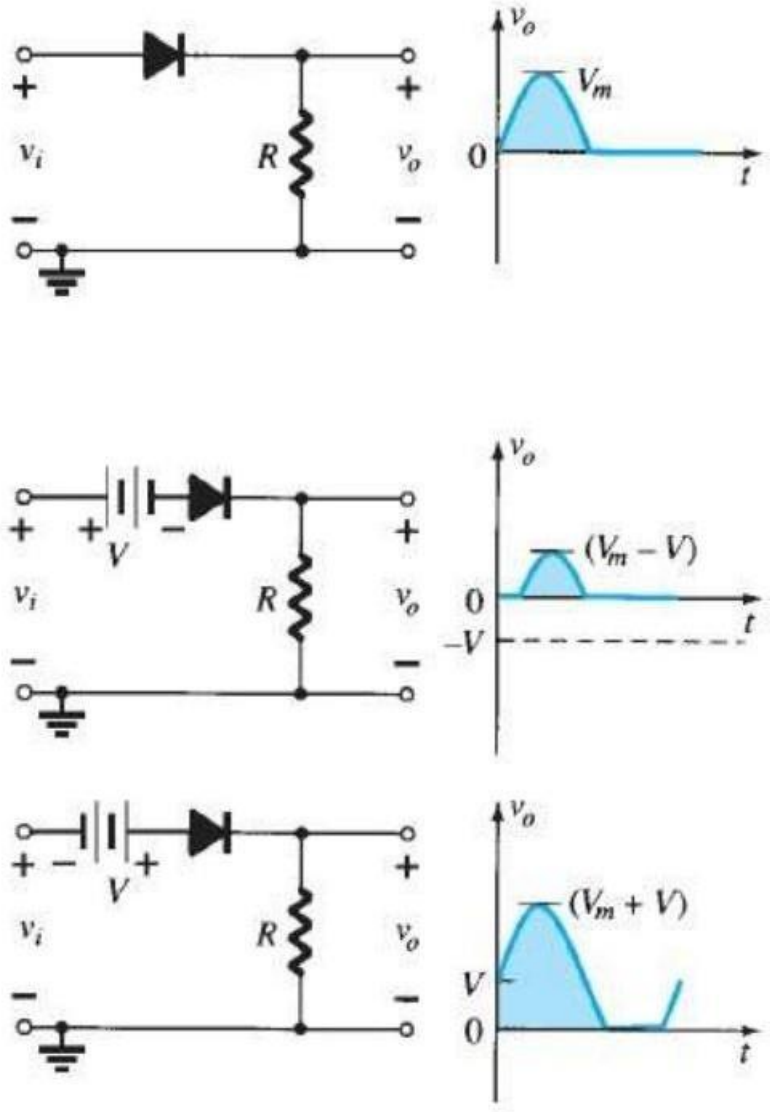
POSITIVE :



Biased Series Clippers (Ideal Diodes)

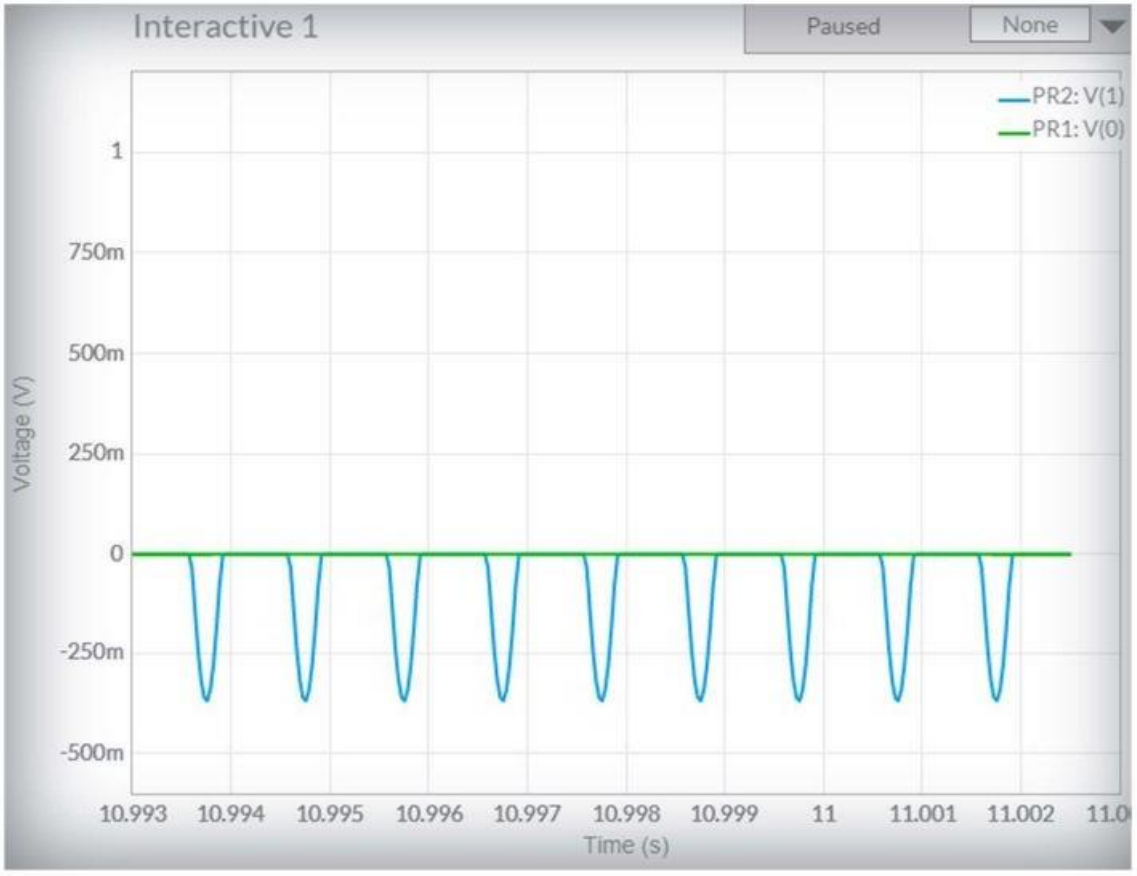


NEGATIVE :



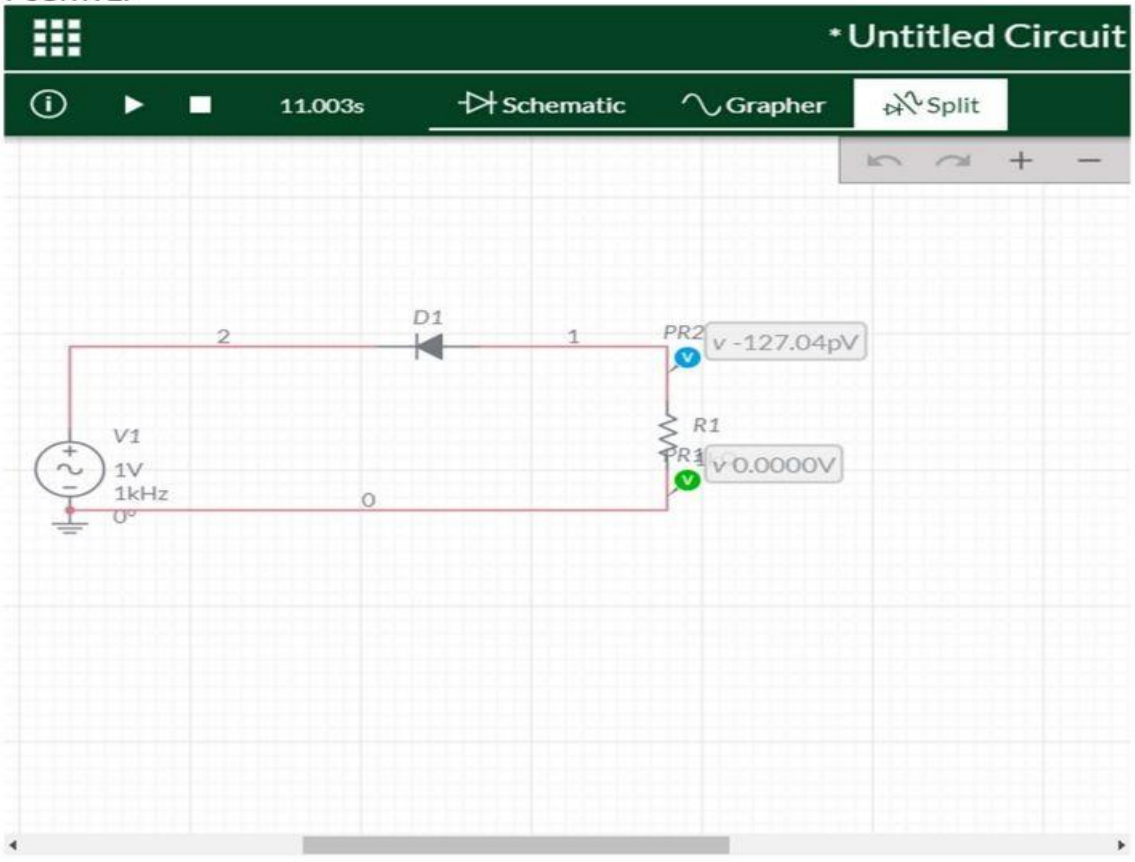
CIRCUIT/CONNECTION AND WAVEFORMS DIAGRAMS (FROM MULTISIM):

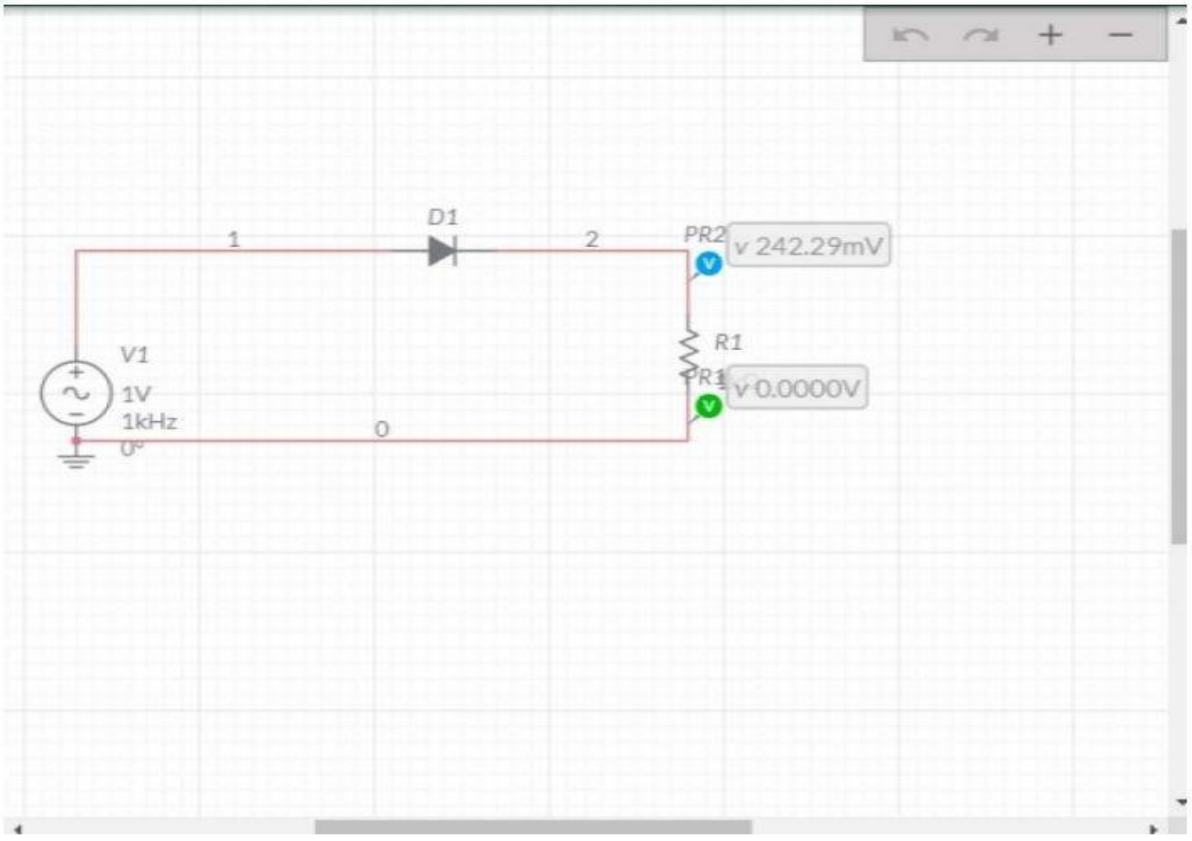
SIMPLE SERIES CLIPPERS (IDEAL DIODES):



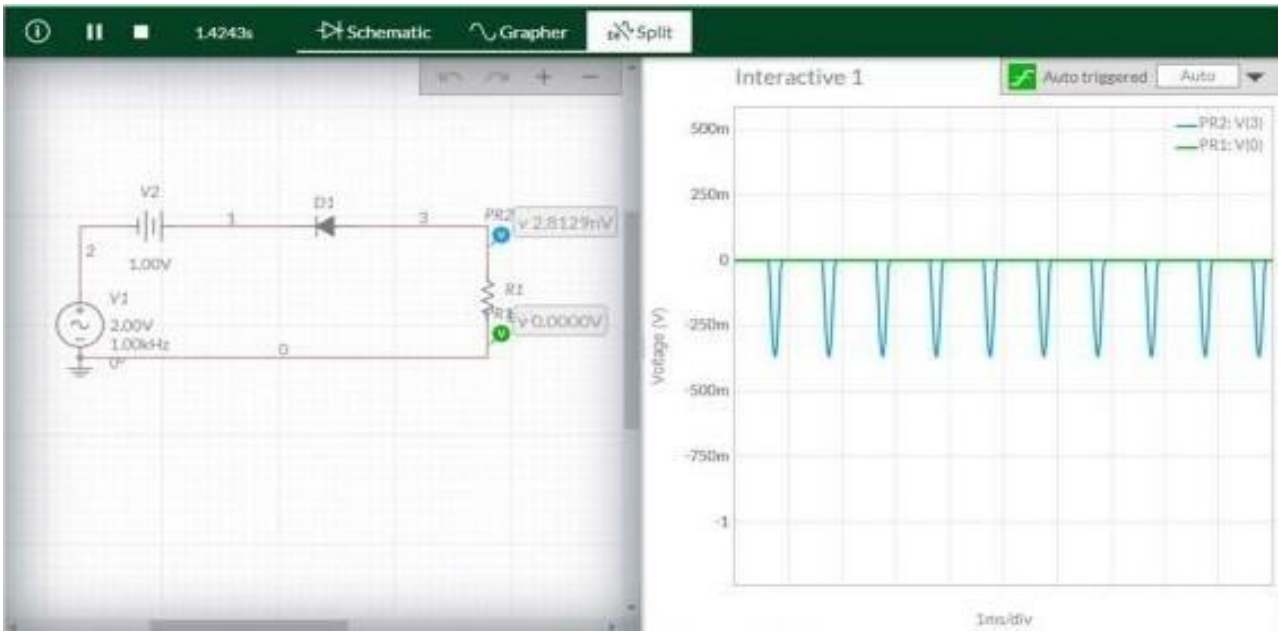
NEGATIVE:

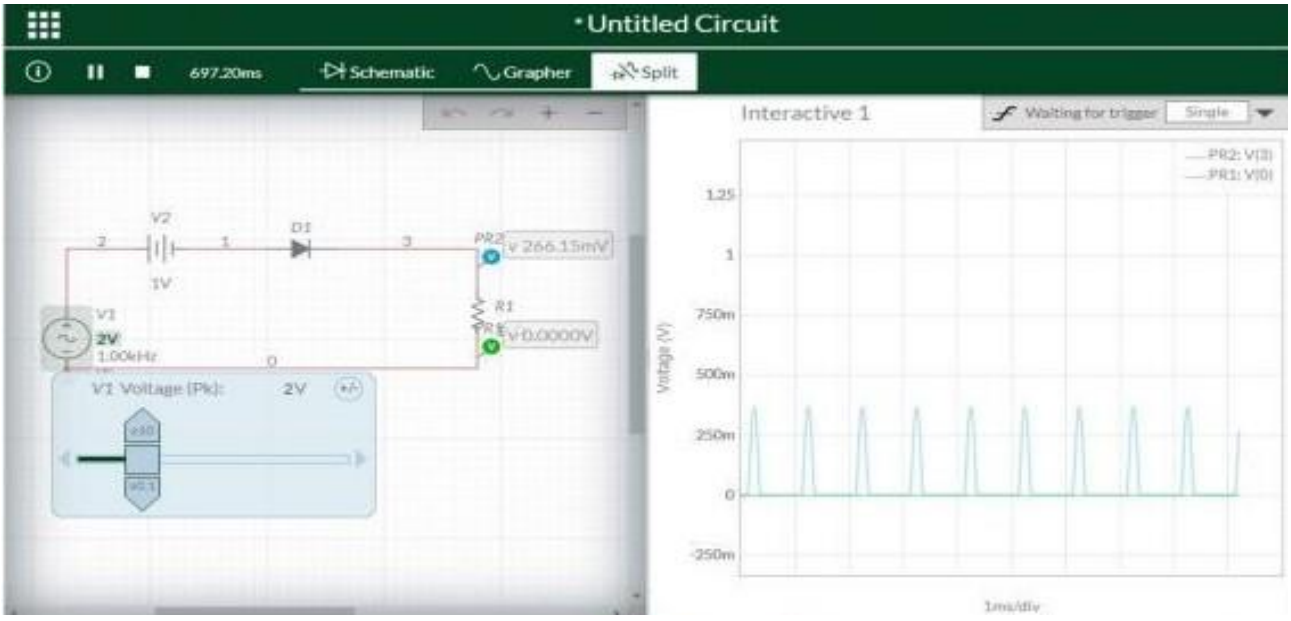
POSITIVE:

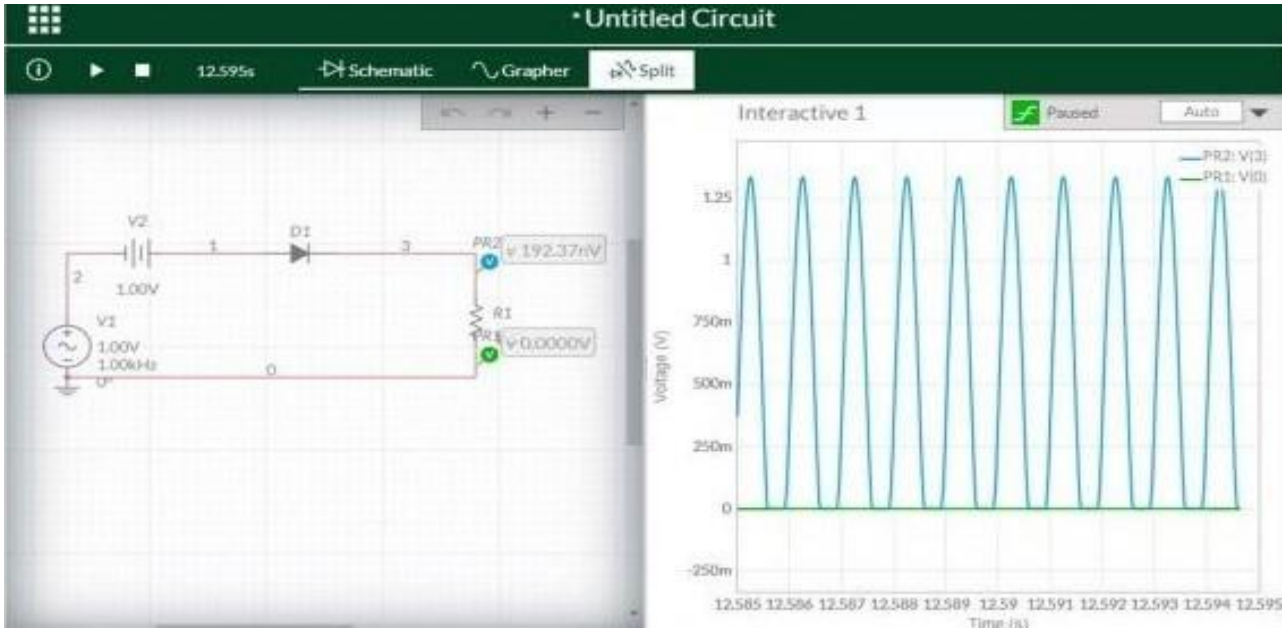


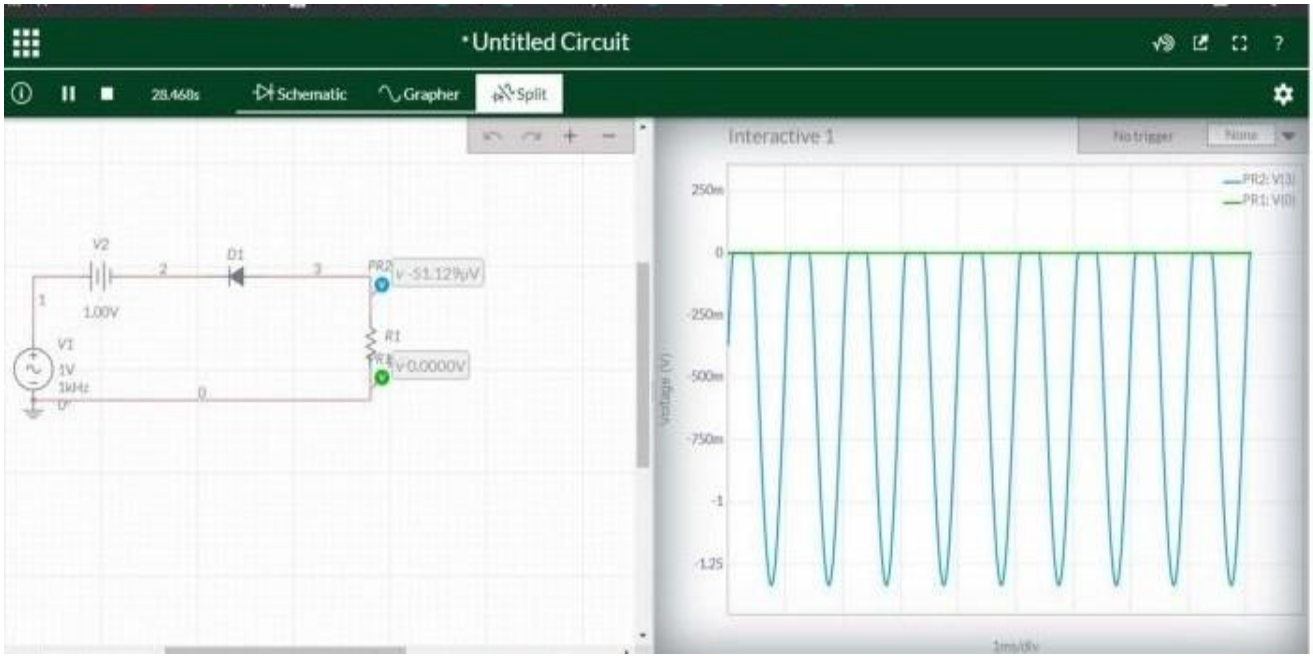


BIASED SERIES CLIPPERS (IDEAL DIODES):

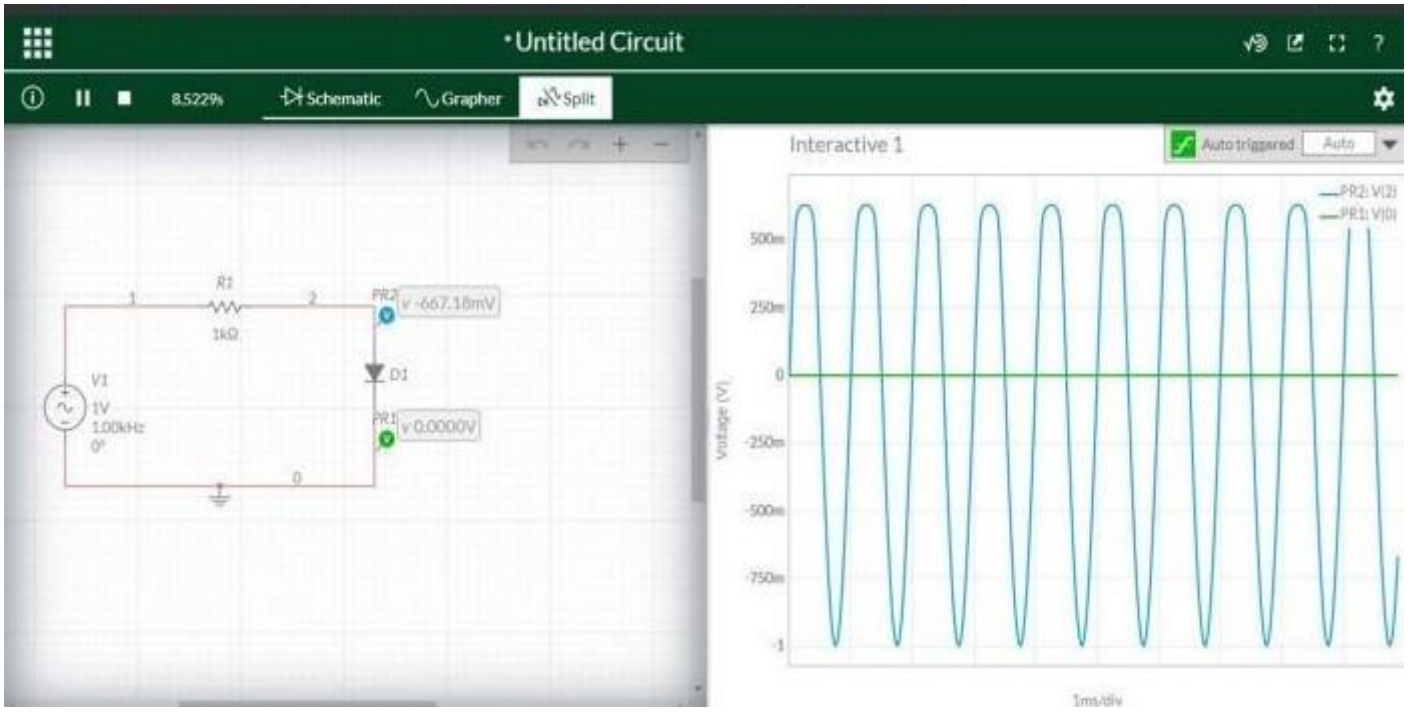

1.4243s
Schematic
Grapher
Split
Interactive 1
Auto triggered
Auto
V2
1.00V
D1
PR2
V 2.8129mV
R1
V 0.0000V
V1
2.00V
1.00kHz
0°
PR2: V(3)
PR1: V(0)
500m
250m
0
-250m
-500m
-750m
-1
Voltage (V)
1ms/div

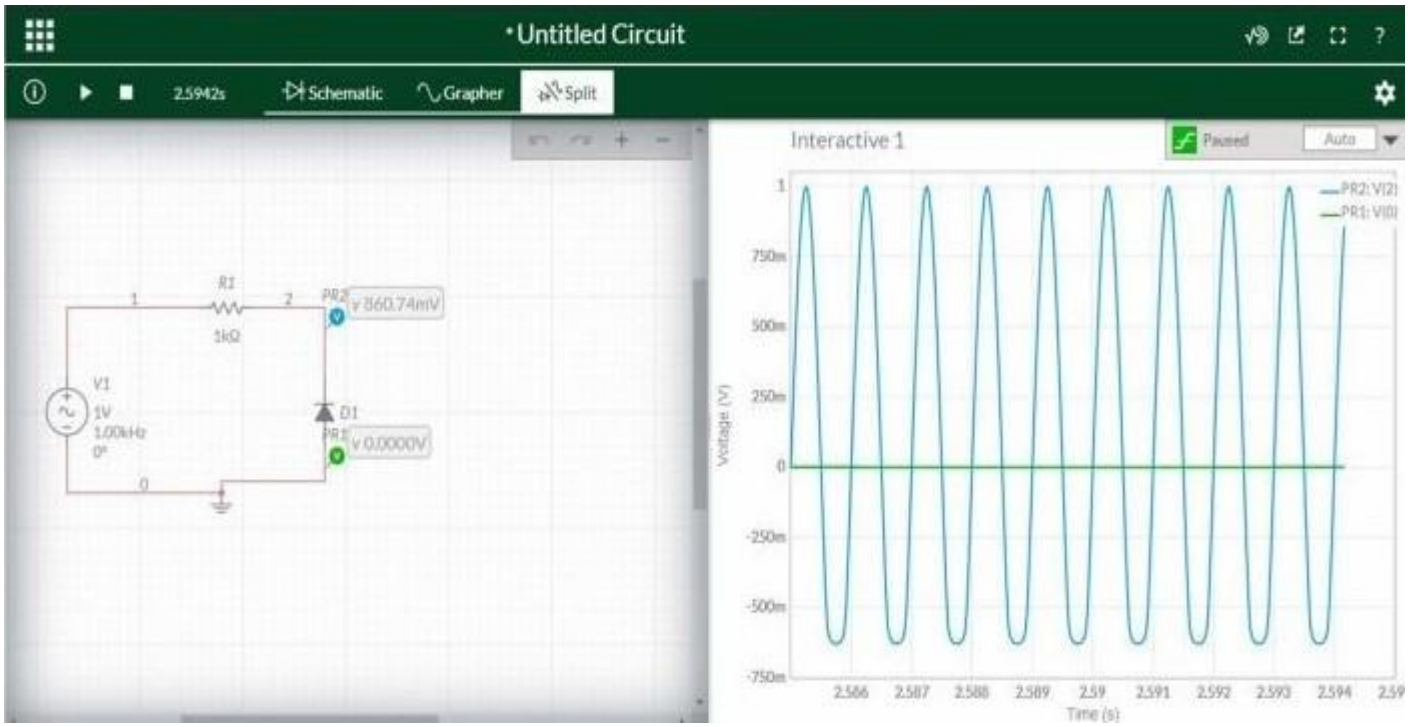

*Untitled Circuit
697.20ms
Schematic
Grapher
Split
Interactive 1
Waiting for trigger
Single
V2
1V
D1
PR2
V 266.15mV
R1
V 0.0000V
V1
2V
1.00kHz
V1 Voltage (Pk):
2V
PR2: V(3)
PR1: V(0)
1.25
1
750m
500m
250m
0
-250m
Voltage (V)
1ms/div


*Untitled Circuit
12.595s
Schematic
Grapher
Split
Interactive 1
Paused
Auto
V2
1.00V
D1
PR2
V 192.37nV
R1
V 0.0000V
V1
1.00V
1.00kHz
0
PR2: V(3)
PR1: V(0)
1.25
1
750m
500m
250m
0
-250m
Voltage (V)
12.585 12.586 12.587 12.588 12.589 12.59 12.591 12.592 12.593 12.594 12.595

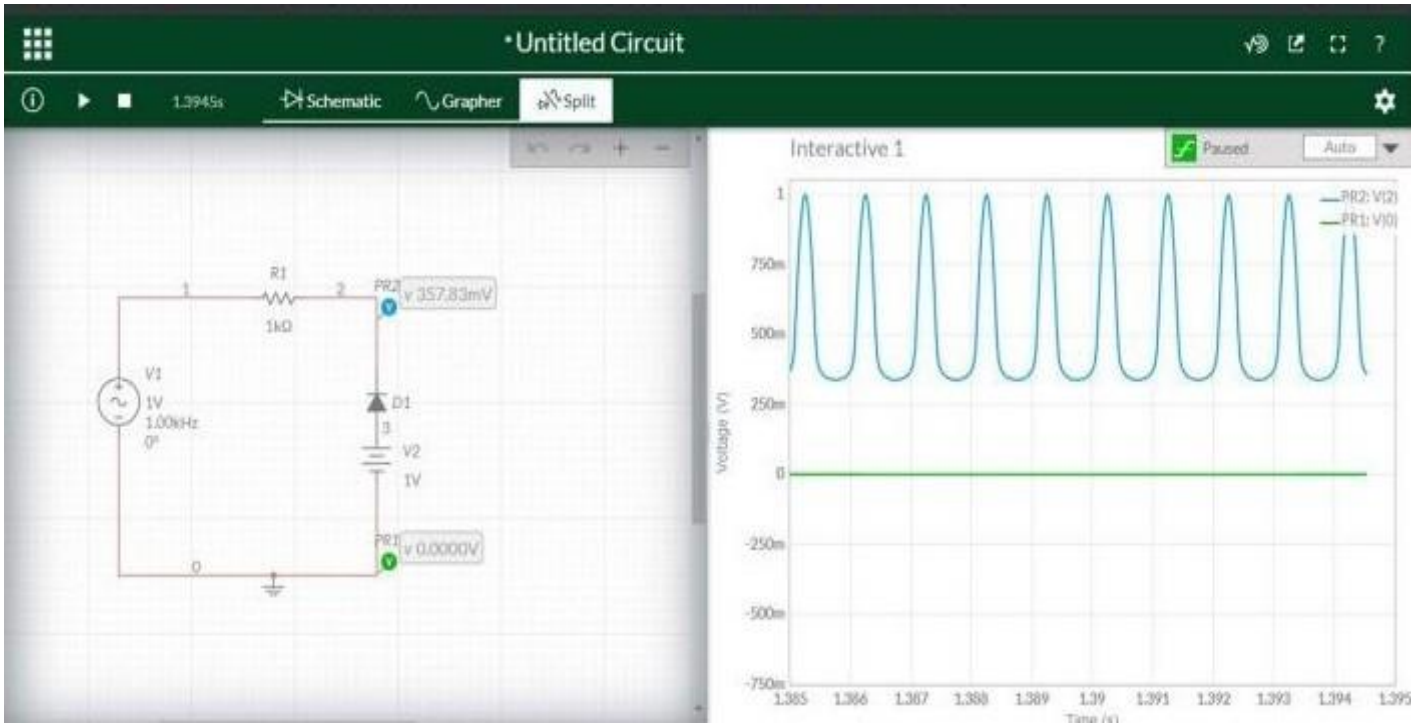

*Untitled Circuit
28.468s
Schematic
Grapher
Split
Interactive 1
No trigger
V2
1.00V
D1
PR2
V -51.129µV
R1
V 0.0000V
V1
1V
1kHz
0
PR2: V(3)
PR1: V(0)
250m
0
-250m
-500m
-750m
-1
-1.25
Voltage (V)

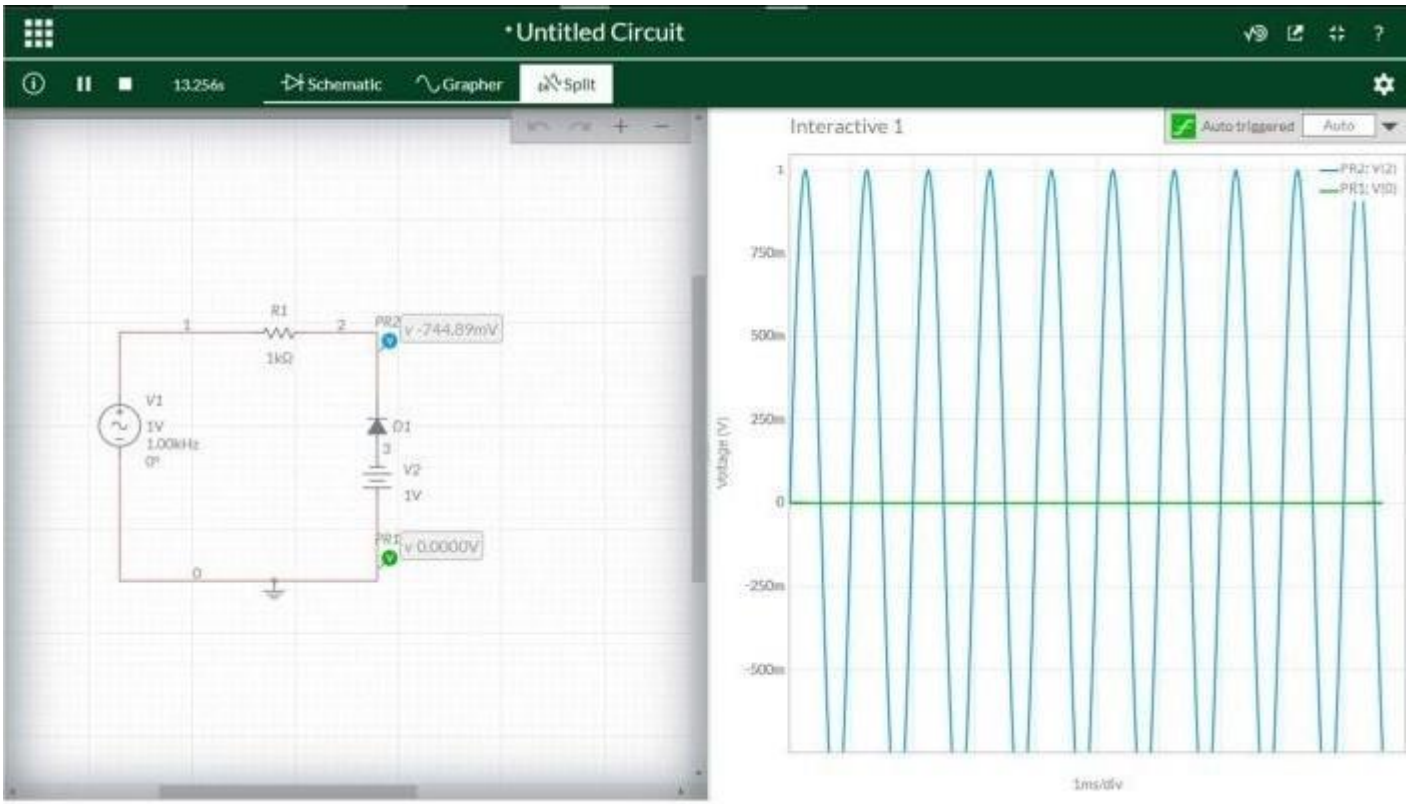
SIMPLE PARALLEL CLIPPERS (IDEAL DIODE)

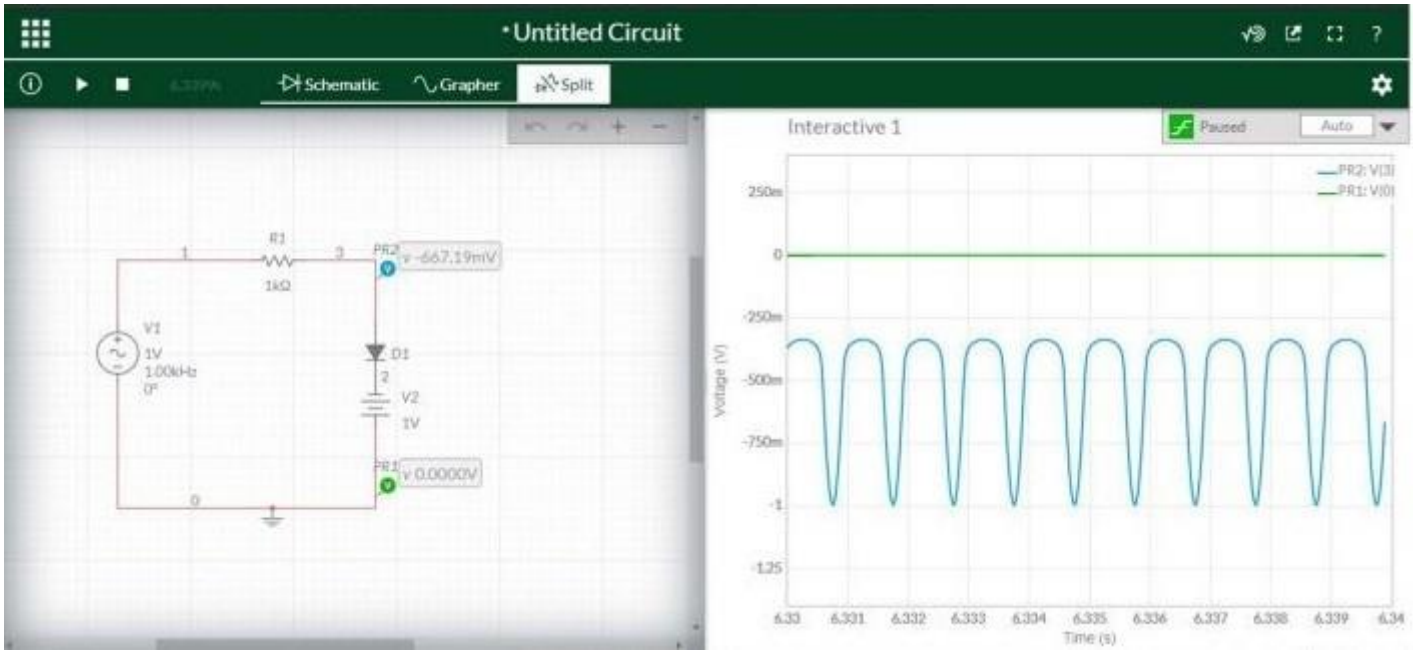


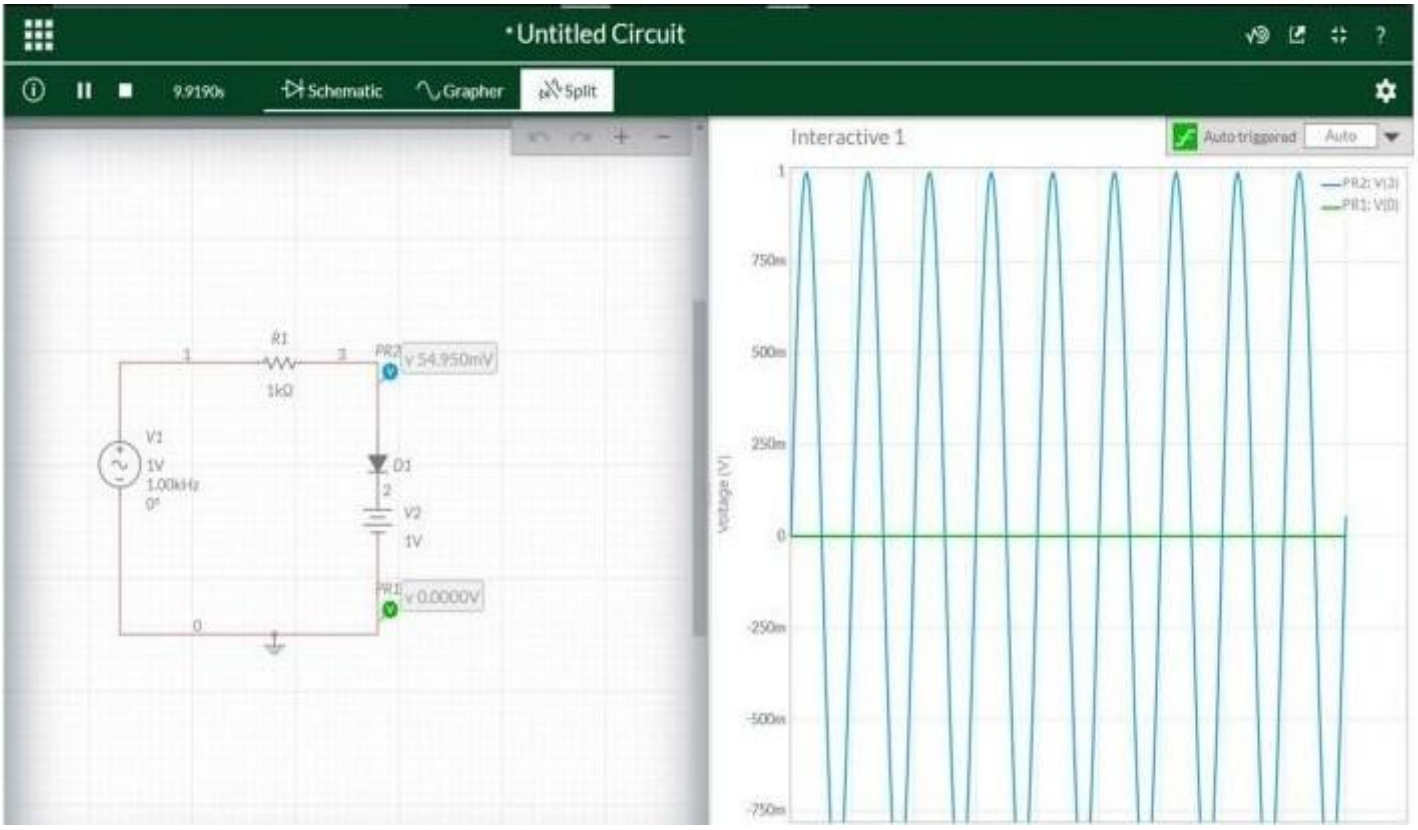


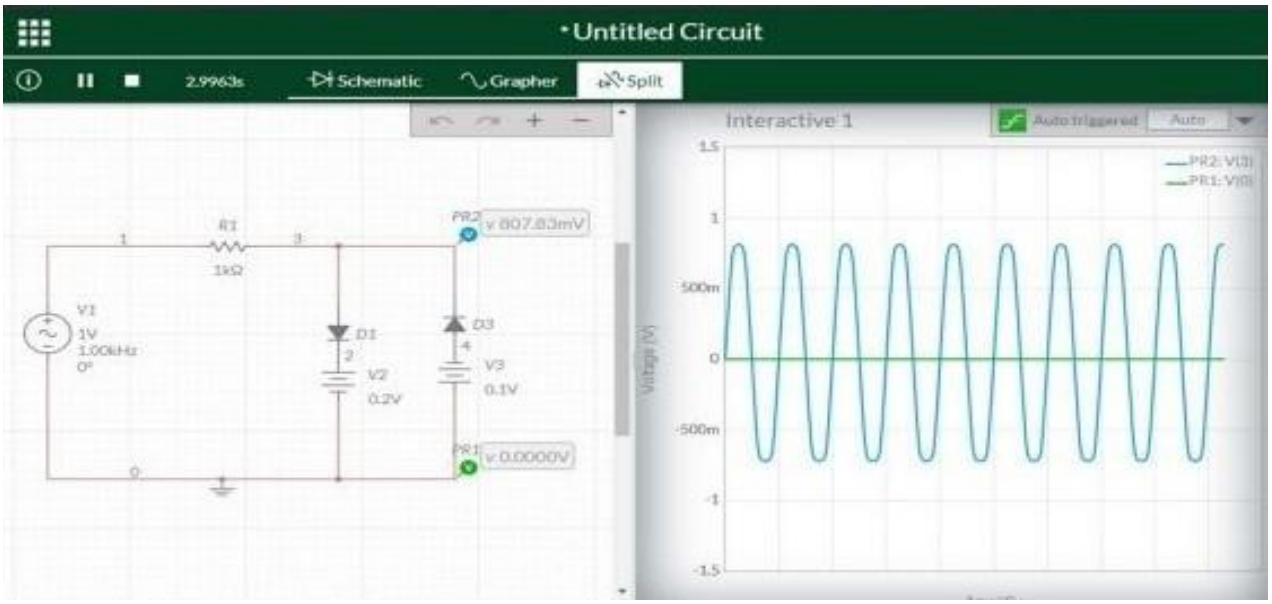
BIASED PARALLEL CLIPPER CIRCUITS (IDEAL DIODES):






Untitled Circuit
Schematic
Grapher
Split
R1
1kΩ
PR2
-667.19mV
V1
1V
1.00kHz
0°
D1
V2
1V
PR1
0.0000V
0
Interactive 1
Paused
Auto
PR2: V(3)
PR1: V(0)
250m
0
-250m
-500m
-750m
-1
-1.25
Voltage (V)
6.33
6.331
6.332
6.333
6.334
6.335
6.336
6.337
6.338
6.339
6.34
Time (s)


Untitled Circuit
9.9190s
Schematic
Grapher
Split
R1
1kΩ
PR2
54.950mV
V1
1V
1.00kHz
0°
D1
V2
1V
PR1
0.0000V
0
Interactive 1
Auto triggered
Auto
PR2: V(3)
PR1: V(0)
1
750m
500m
250m
0
-250m
-500m
-750m
Voltage (V)

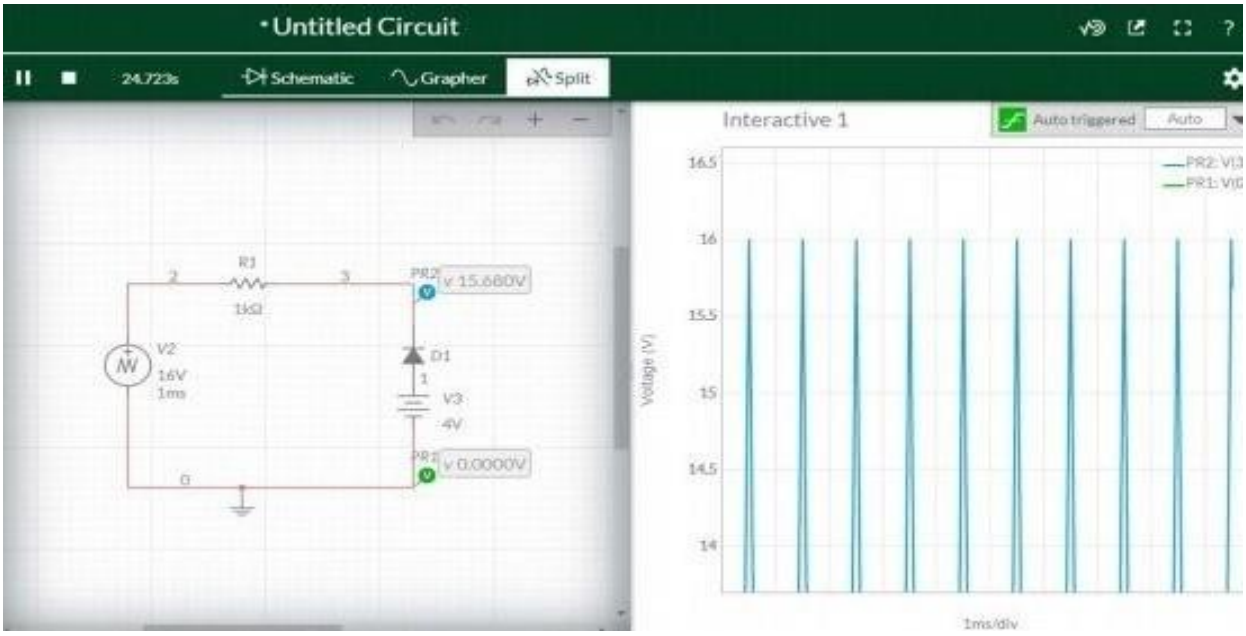


CONCLUSIONS:

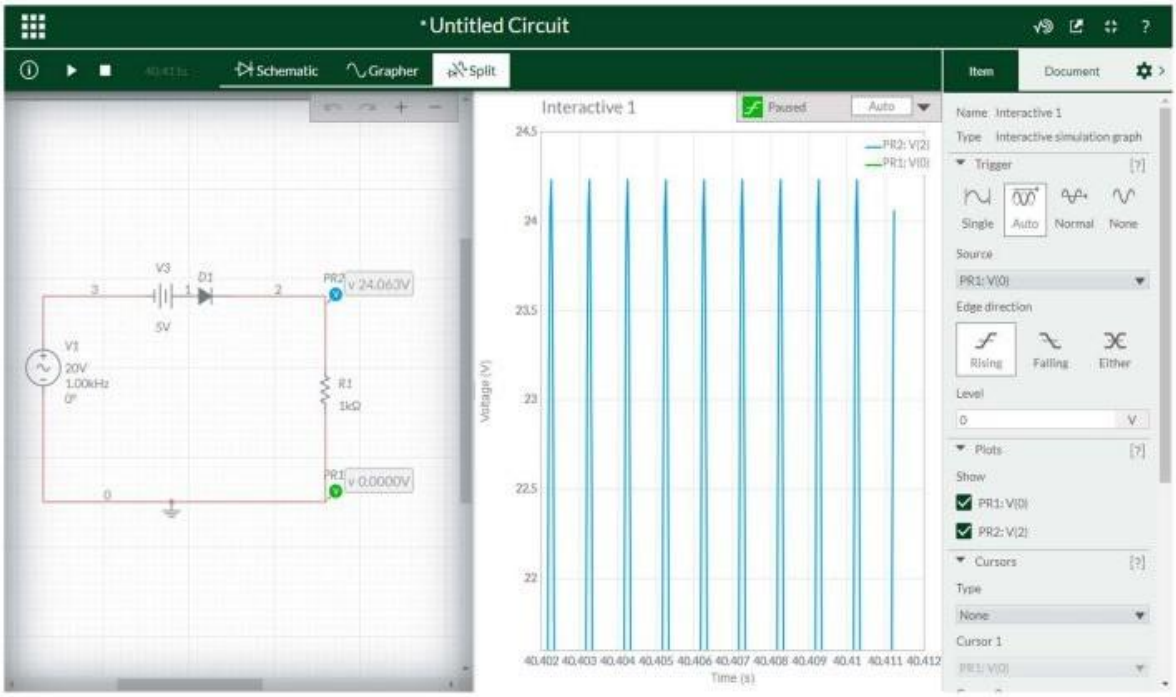
Here, the theoretical and practical characteristics of varies negative and positive and positive series clipper (with and without based) are same. Hence verified.

ASSIGNMENT:

QUESTION 1-



QUESTION 2:

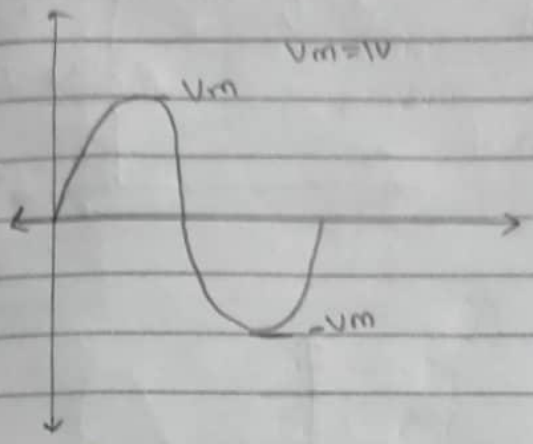

*Untitled Circuit
Schematic
Grapher
Split
V3
5V
D1
PR2
24.063V
V1
20V
1.00kHz
0°
R1
1kΩ
PR1
0.0000V
0
Interactive 1
Paused
Auto
PR2: V(2)
PR1: V(0)
Voltage (V)
Time (s)
Item
Document
Name Interactive 1
Type Interactive simulation graph
Trigger
Single
Auto
Normal
None
Source
PR1: V(0)
Edge direction
Rising
Falling
Either
Level
Plots
Show
Cursors
Type
None
Cursor 1

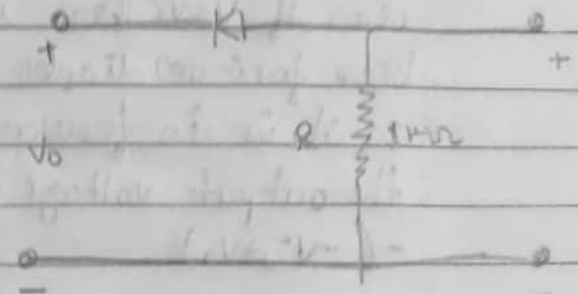
Calculations:

DELD - 1 (Practical)

U20CS100_ ADITYA RAJ

Calculations :

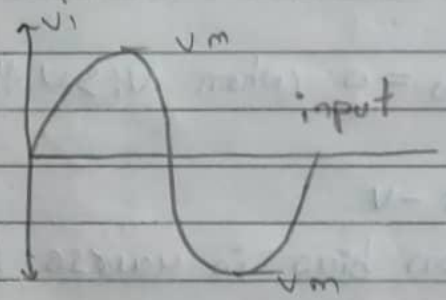
① 

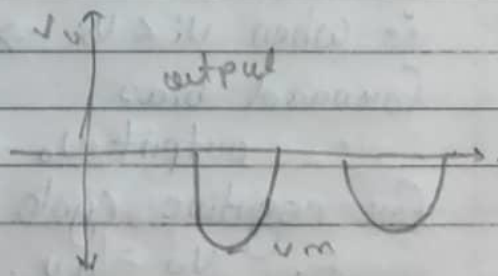


Given, here diode is ideal.

For positive cycle it is in reverse bias.
∴ The Circuit opens
∴ $V_o = 0V$

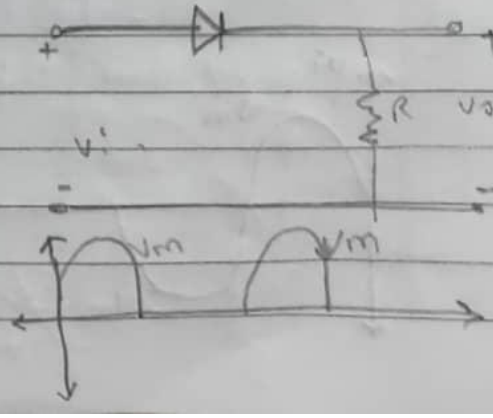
For negative cycle:
it is in forward bias
∴ Diode behaves as Conductor.
∴ $V_o = V_i = 1V$.



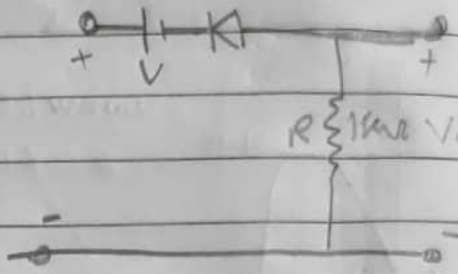


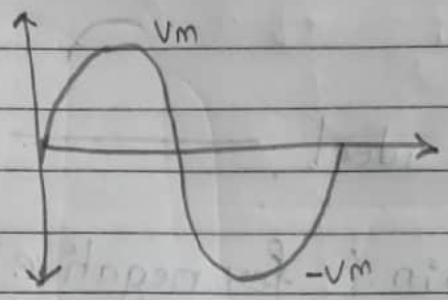
2.) → For positive cycle. It is in forward bias. The diodes behaves as conductor.
∴ $V_o = V_i = 1V$

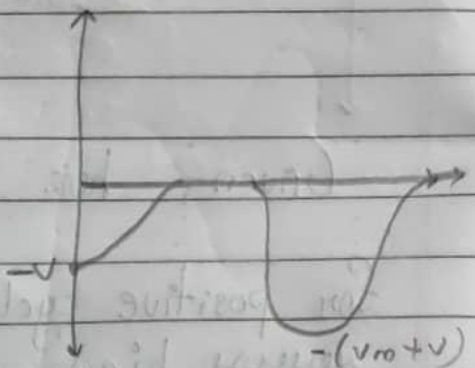
→ For negative cycle. It is in Reverse bias. The diode behaves as insulation:
∴ $V_o = 0V$.



* for the Circuit for positive cycle when $V > V_i$ then it is forward bias if $V < V_i$ then reverse bias for (-ve) diode as it is in forward bias the output voltage is $-(-V_i + V_0)$







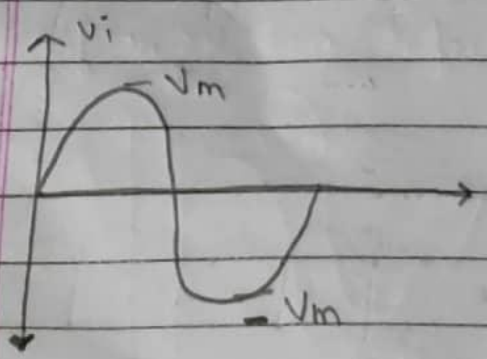
* for Positive cycle of circuit when $V_i < V_0$, then it is in reverse bias

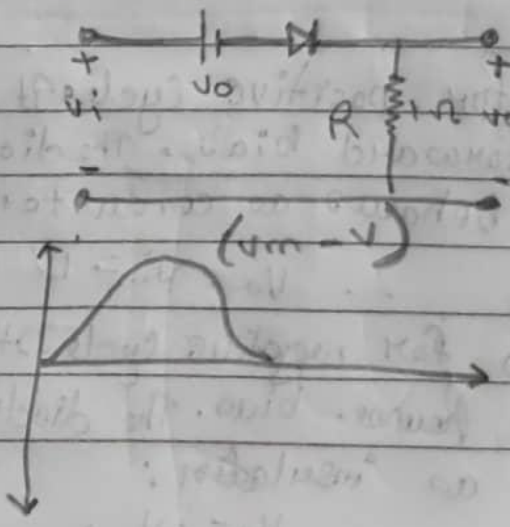
∴ when $V_i < V_0 \Rightarrow V_0 = 0$ when $V_i > V$ then forward bias

∴ output $V_0 = V_i - V$

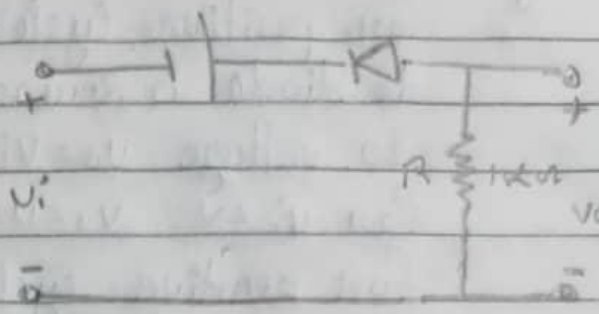
for negative cycle then bias is reverse bias

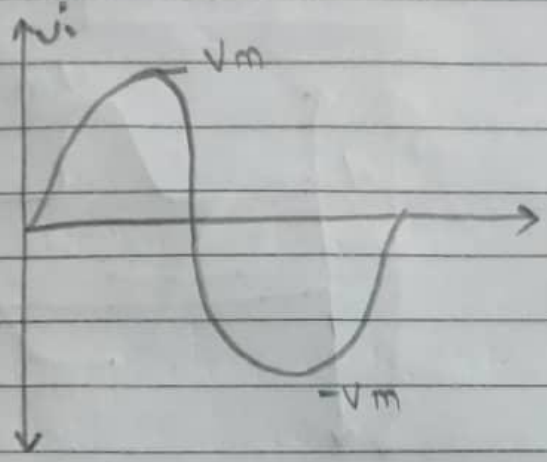
∴ $V_0 = 0$ V.

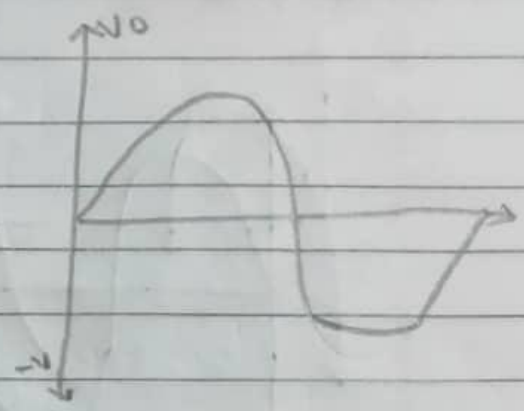




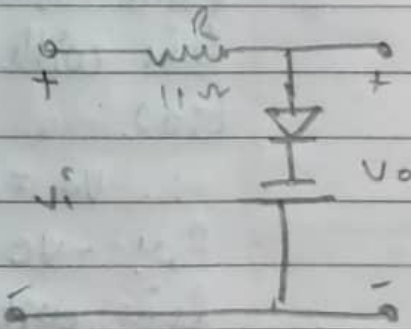
* for Positive Cycle the Circuit.
it is in reverse bias
∴ $V_o = 0V$.
for negative Cycle.
if $v > V_i$ then reverse.
Biad. for $v > V_i$, $V_o = 0V$.

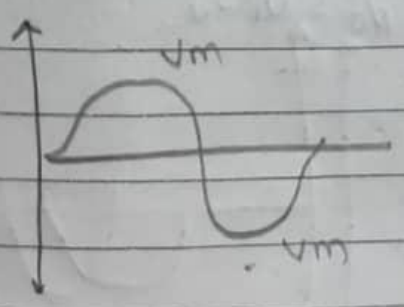


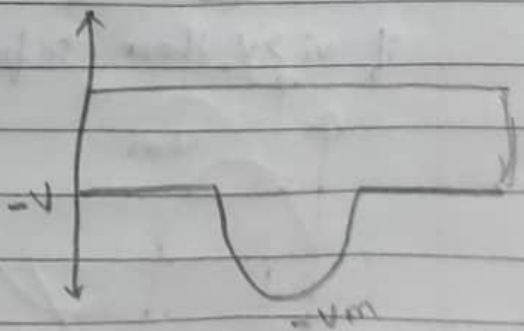




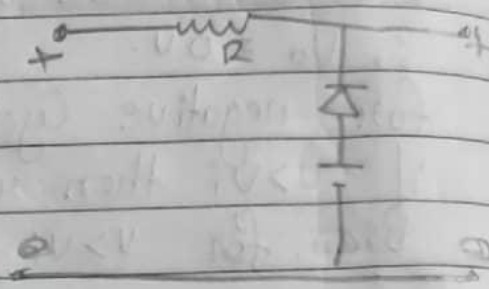
* for positive Cycle.
the diode is forward biased.
So the voltage across the series.
$V_o = V$.
for negative cycle it is.
Reverse biased.
when $V_i > V$ the $V_o = V_i$.
if $V_i < V$ then $V_o = V$.

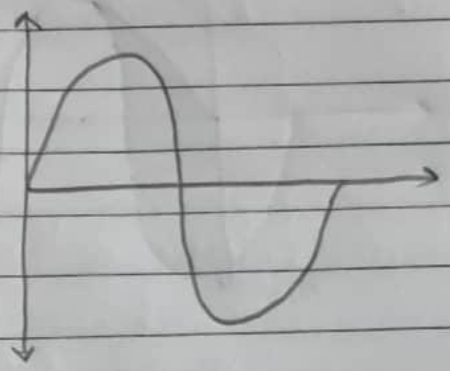


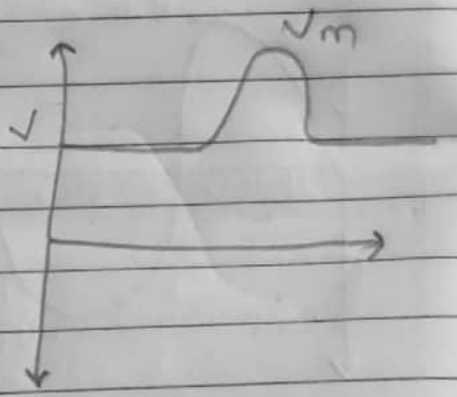




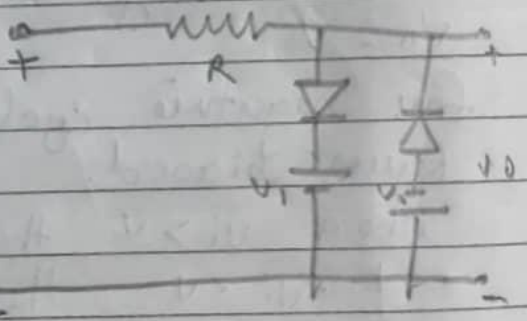
* for positive cycle
the diode is Reverse diode.
So, voltage $V_o = V_i$ ($V_i > V$)
for $V_i < V$ $V_o = V$
for negative cycle forward biased.
So, $V_o = V$.



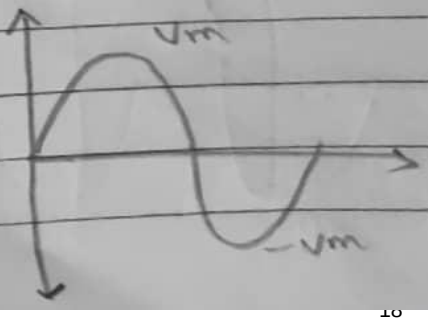


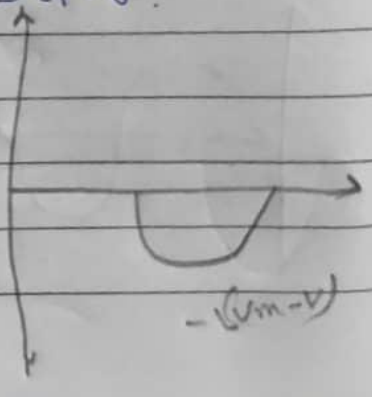


* Here for positive cycle.
Line with V_i is forward biased.
$\therefore V_o = V_i$
for -ve cycle
line with V_o is forward biased
$\therefore V_o = V_2$.



if $V_i > V$ then in forward bias. $V_o = V_i - V$.





* for positive cycle it is in forward bias.

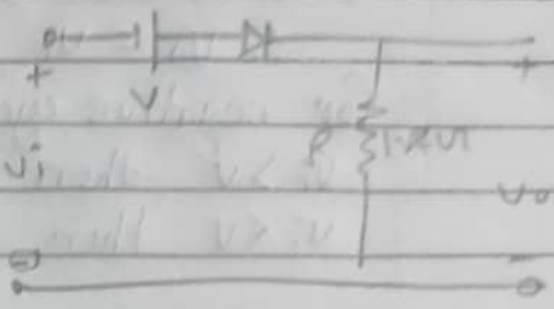
$\therefore V_o = V_i + V$

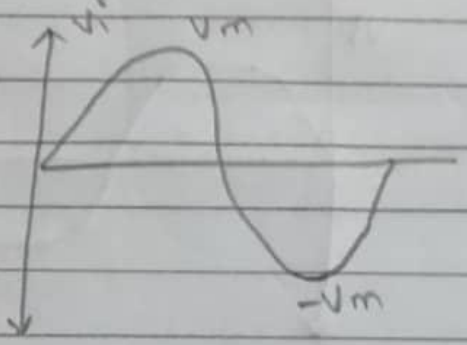
for negative cycle it is in reverse bias, if $V_i > V$,

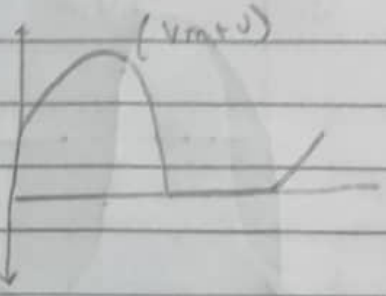
$\therefore$ if $V_i > V \Rightarrow V_o = 0$.

if $V_i < V$

$\therefore V_o = V - V_i$







* for positive cycle Broken.

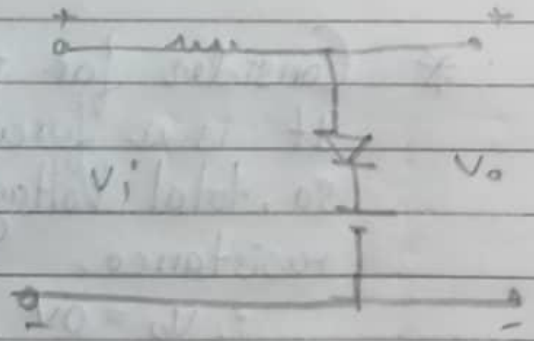
$V > V_i$, it is in forward bias..

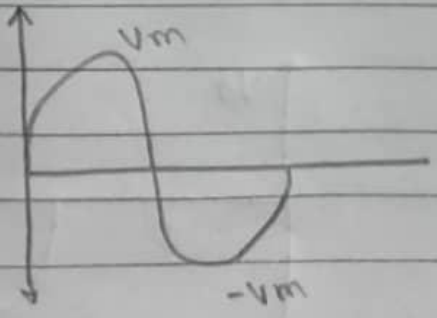
$\therefore V_o = V$

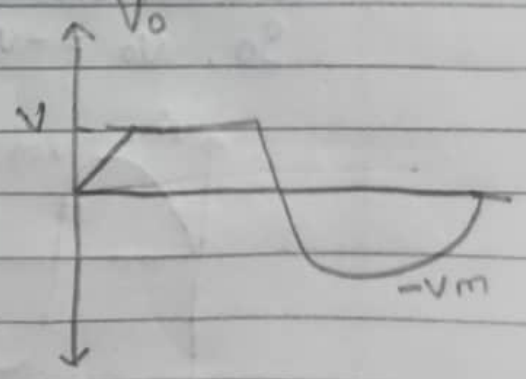
when $V_i > V$ then $V_o = 0$.

for negative cycle, it is in forward bias.

$\therefore V_o = V_i$







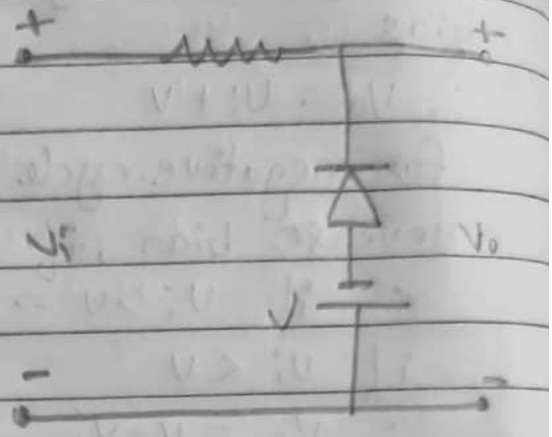
* for positive cycle then it is Reverse bias.

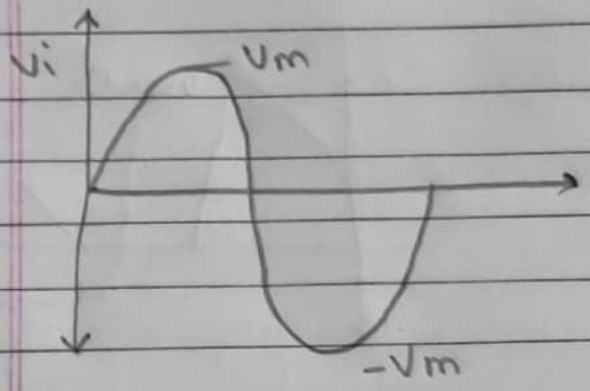
$\therefore V_o = V_i$

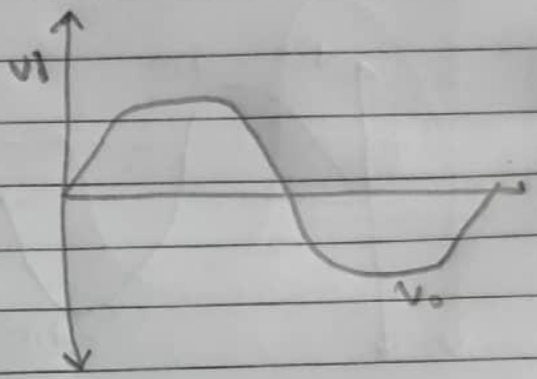
for negative cycle when.

$V_i > V$ then $V_o = 0$

$V_i < V$ then $V_o = V$.





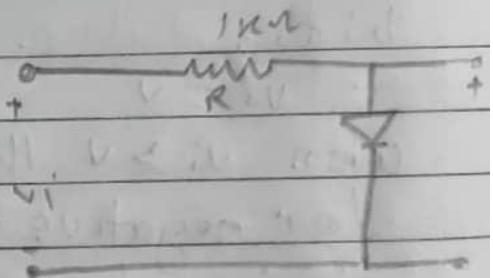


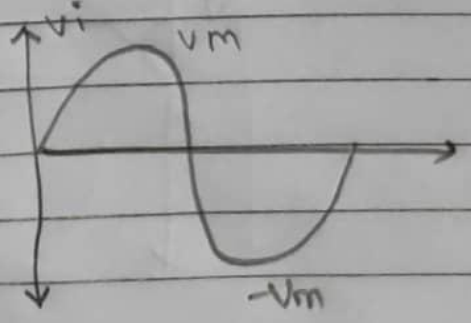
* Consider for positive cycle It is a forward biased. so, total Voltage taken by resistance.

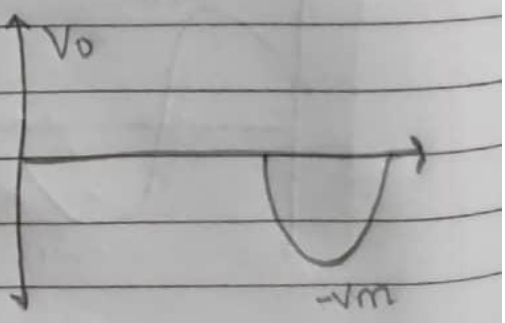
$\therefore V_o = 0V$

for negative cycle, it is reverse biased.

So, $V_o = -V_i V$.







* Consider for positive cycle.
It is negative biased (reversed). so, $v_o = 0 v_i$.
for, negative cycle forward bias,
so, $v_o = 0$.