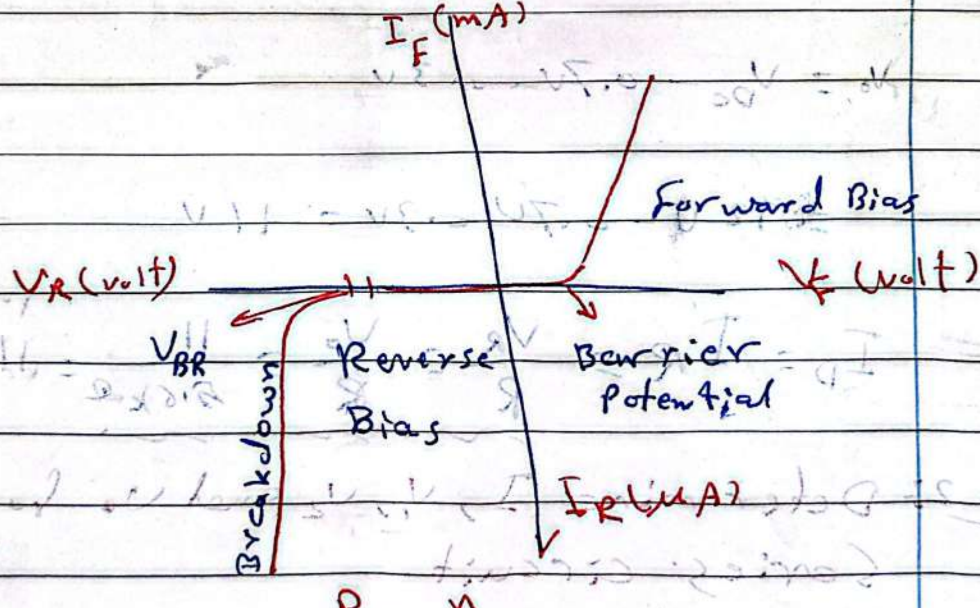
ch. 2

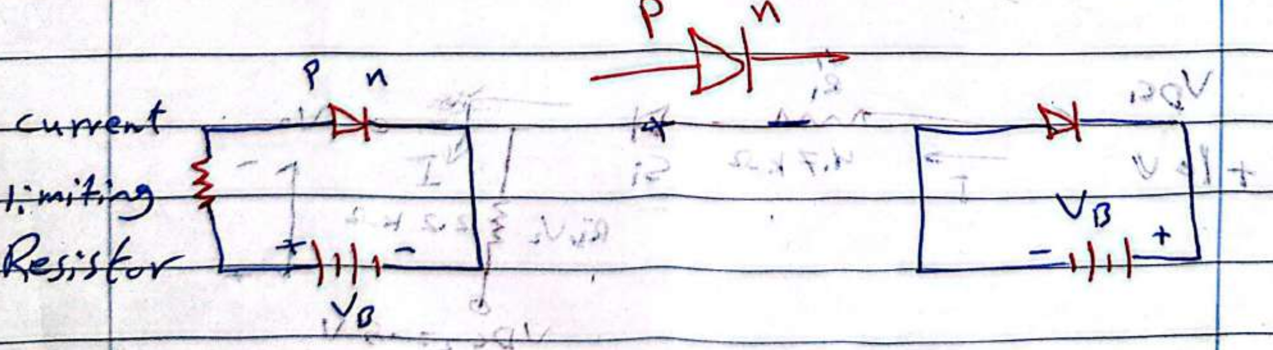
Diodes and Applications

2.1 The Diode characteristic Curve.

- in forward bias There is very little forward current below barrier potential

- in reverse bias, as The reverse voltag increase The current remains near 0(zero) until The break down voltage is reached.

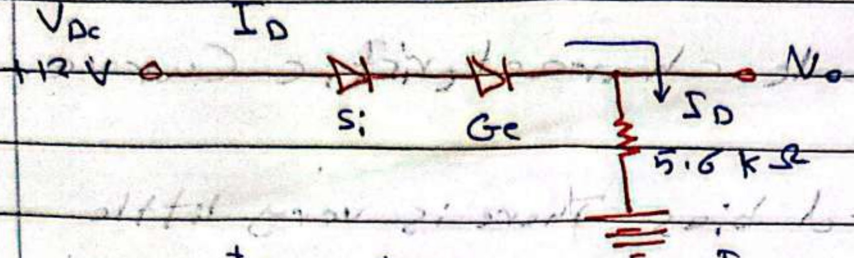




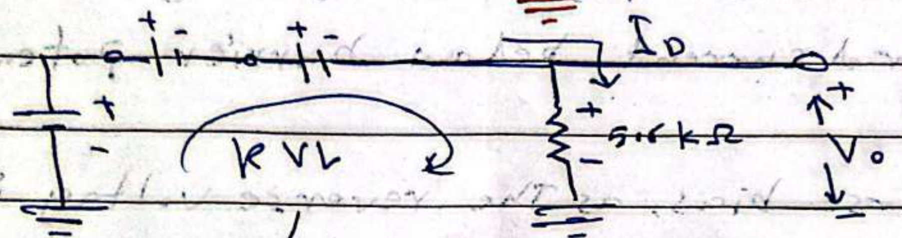
forward Bias

Reverse Bias

Ex) 1: Determine V_{out} (V_o) an I_D for The Series circuit.



Sol



equivalent circuit model

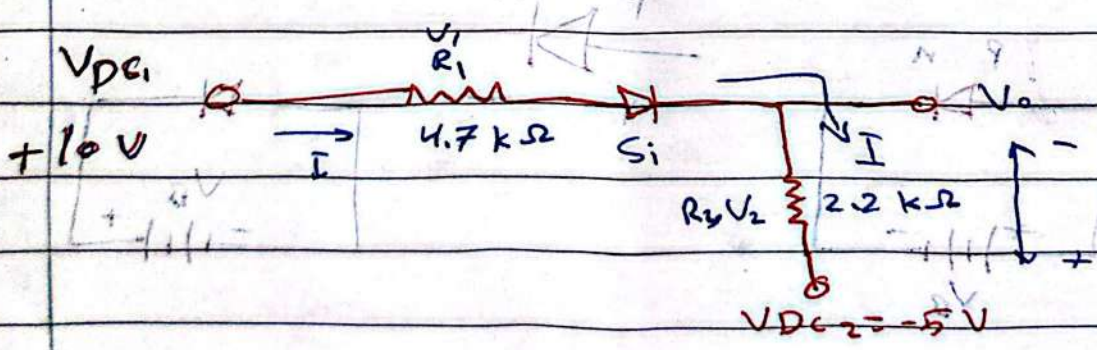
KVL → kirshof voltag law

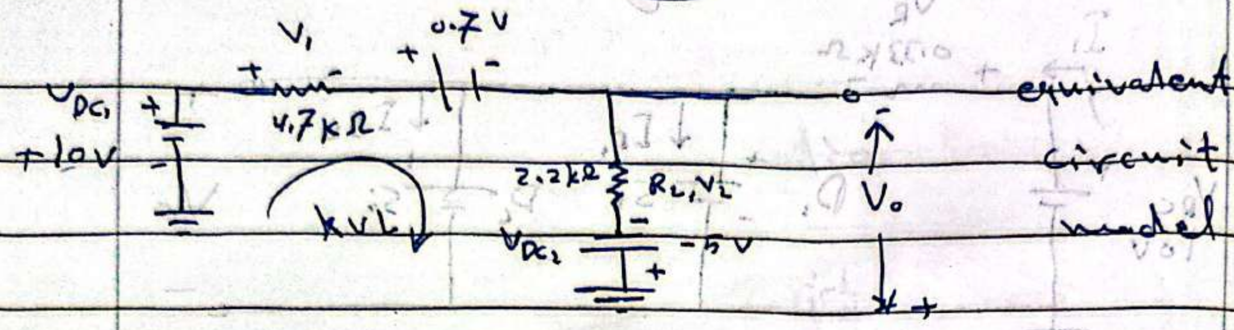
$$V_o = V_{DC} - 0.7V - 0.3V$$

$$= 12V - 0.7V - 0.3V = 11V$$

$$I_D = I_R = \frac{V_R}{R} = \frac{V_o}{R} = \frac{11V}{5.6k\Omega} = 1.96 \text{ mA}$$

Ex 2: Determine I, V_1, V_2 and V_o for The Series circuit.





$$I = \frac{V_{DC_1} + V_{DC_2} - 0.7}{R_1 + R_2} = \frac{10V + 5V - 0.7}{4.7k\Omega + 2.2k\Omega}$$

$$= \frac{14.3\ V}{6.9\ k\Omega} = 2.07\ mA$$

$$V_1 = IR_1 = (2.07\ mA)(4.7\ k\Omega) = 9.73\ V$$

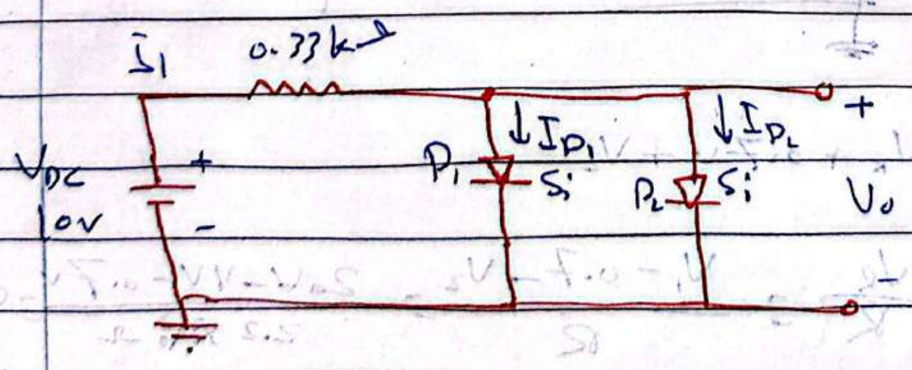
$$V_2 = IR_2 = (2.07\ mA)(2.2\ k\Omega) = 4.55\ V$$

Applying KVL

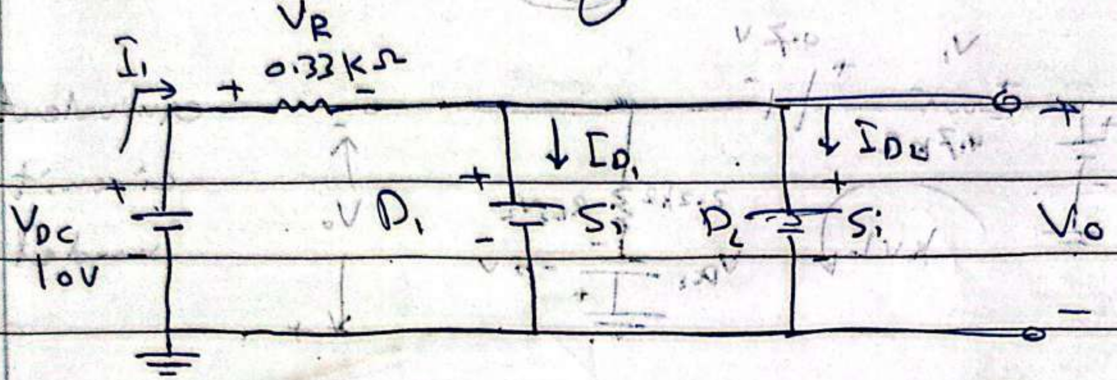
$$-V_{DC_2} + V_2 - V_0 = 0 \Rightarrow V_0 = V_2 - V_{DC_2}$$

$$V_0 = 4.55V - 5V = -0.45V$$

Ex)3: Determin V_0, I_1, I_{D_1} and I_{D_2} for the parallel diode configuration:



Sol:

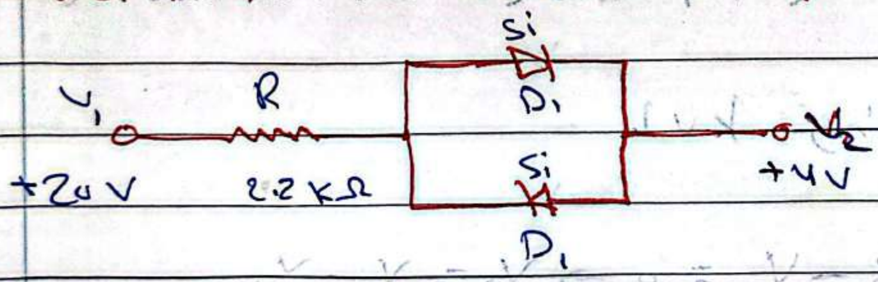


$V_o = 0.7$

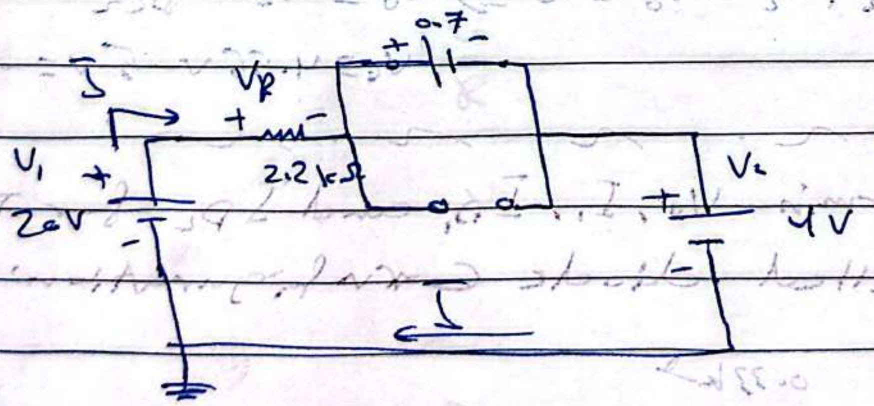
$$I_1 = \frac{V_R}{R} = \frac{V_{DC} - 0.7}{R} = \frac{10 - 0.7}{0.33\,k\Omega} = 28.18\,mA$$

$$I_{D_1} = I_{D_2} = \frac{I_1}{2} = \frac{28.18\,mA}{2} = 14.09\,mA$$

Ex4 Determint the current I for the network



Sol:

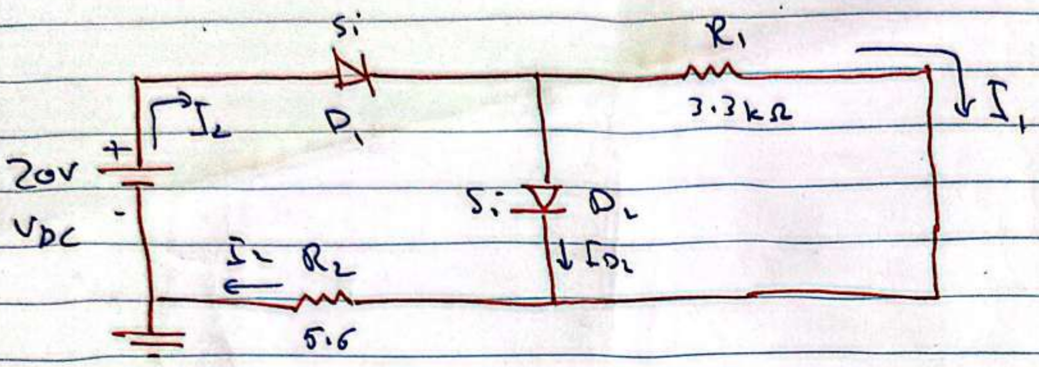


equivalent circuit model

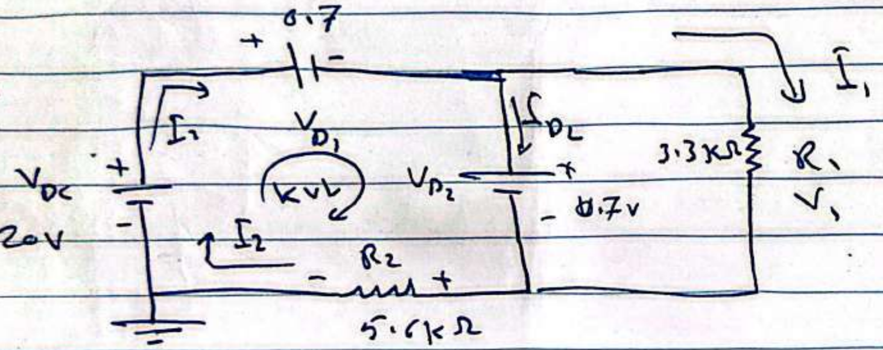
$$V_1 = V_R + 0.7\,V + V_2$$

$$I = \frac{V_R}{R} = \frac{V_1 - 0.7 - V_2}{R} = \frac{20\,V - 4\,V - 0.7\,V}{2.2 \times 10^3\,\Omega} = 9.65\,mA$$

Ex) Determine the currents I_1, I_2 and I_{D_2}, I_{D_1} for the network



Sol)



$$I_1 = \frac{V_{D_2}}{R_1} = \frac{0.7\,V}{3.3\,k\Omega} = 0.212\,mA$$

$$V_{DC} = V_2 + V_{D_1} + V_{D_2} \Rightarrow V_2 = V_{DC} - V_{D_1} - V_{D_2}$$

$$V_2 = 20V - 0.7v - 0.7v$$

$$V_2 = 18.6\,V$$

$$I_2 = \frac{V_2}{R_2} = \frac{18.6\,V}{5.6\,k\Omega} = 3.32\,mA$$

$$I_{D_2} = I_2 - I_1 = 3.32\,mA - 0.212\,mA$$

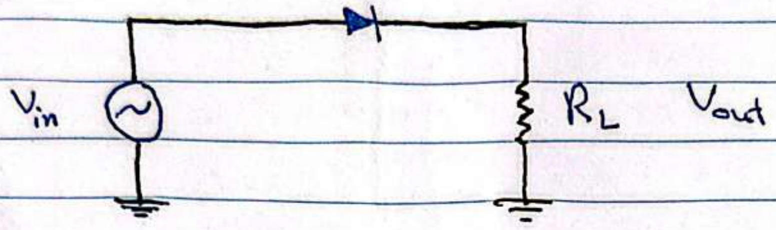
$$= 3.108\,mA$$

Rectifiers

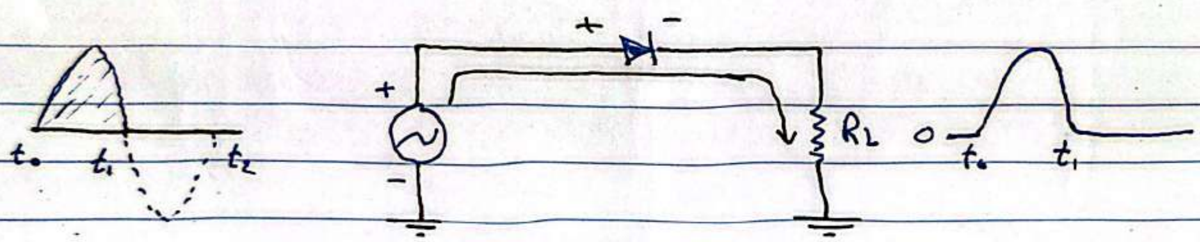
~~Half-wave Rectifier~~ :-

Because of Their unique (فريد) ability to conduct in only one direction, diodes are used in rectifier (مقوم) circuits. Rectification is The process of of converting ac, to pulsating dc.

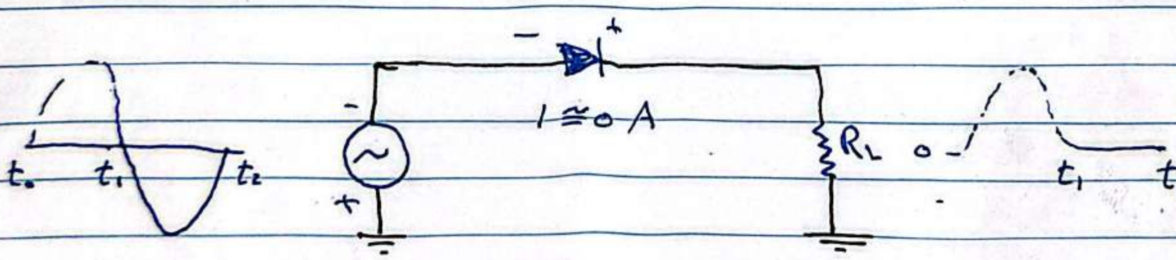
~~pulsating~~



A. half-wave rectifier circuit.

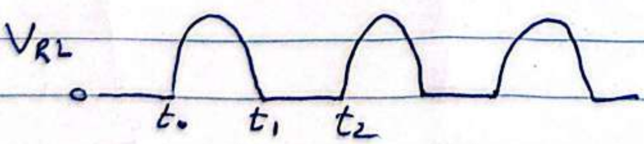


B. operation during positive alternation.



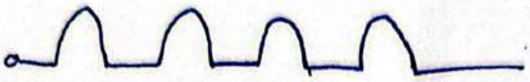
C. operation during negative alternation

Hw



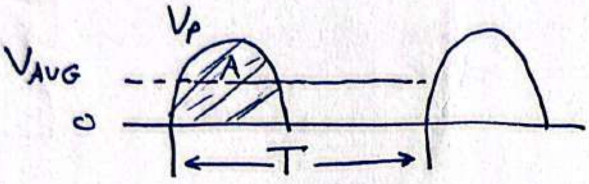
D. Half-wave output voltage.

$V_p = 100V$



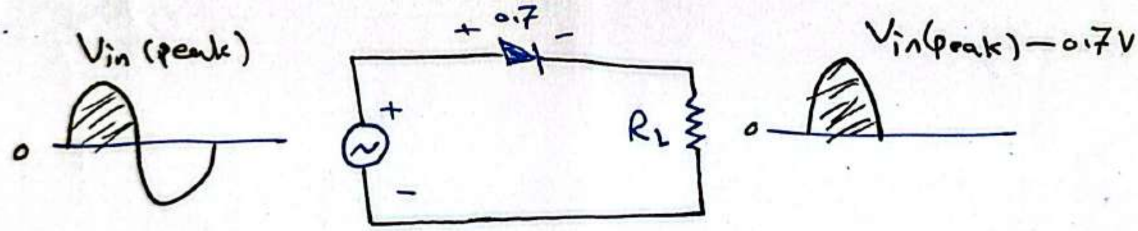
$$V_{dc} = V_{AVG} = \frac{V_p}{\pi} = \frac{100V}{\pi} = 31.83\ V$$

* The average value is the value that would be indicated by a dc volt meter.



Average value of half-wave rectified signal.

* Effect of Barrier potential on half-wave Rectifier output.



$V_{p(out)} = V_{p(in)} - 0.7V$, for silicon.

$V_{p(out)} = V_{p(in)} - 0.3V$, for germanium.

2.3 :- Half-wave Rectifier with Transformer-Coupled Input.

مصدر

* Transformer allows The source voltage to be stepped up or stepped down as needed.

* Transformer electrically isolated ac power source from rectifier circuit

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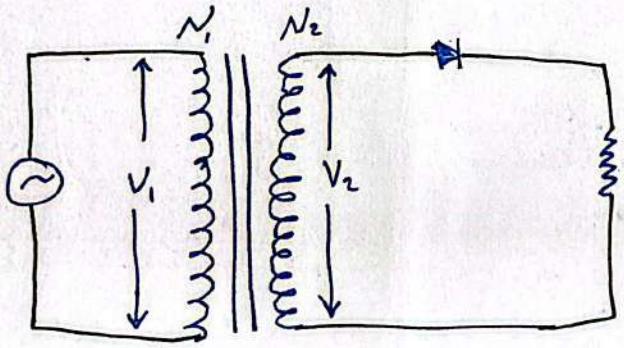
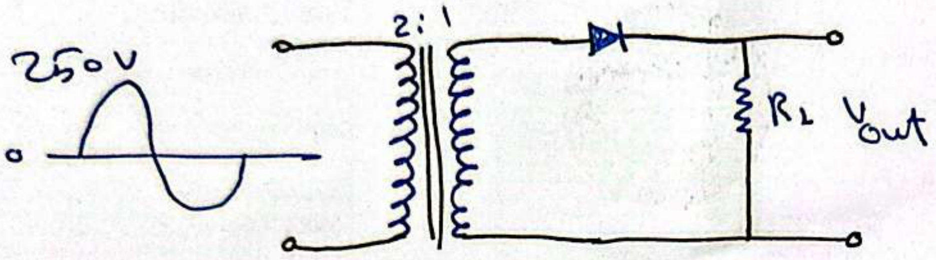
Thus reducing shock hazard.



$$V_2 = \left(\frac{N_2}{N_1}\right) V_1$$

- if $N_2 > N_1$, the primary voltage is less than the secondary voltage.
- if $N_2 < N_1$, the primary voltage is greater than The secondary voltage.

ex) Determine The peak value of The output voltage.



Solu

$$\frac{N_2}{N_1} = \frac{1}{2} = 0.5$$

$$V_2 = \left(\frac{N_2}{N_1}\right) V_1$$

$= 0.5(250V) = 125V$, is The secondary peak voltage is.

to ~~calculat.~~ determinet the peak rectified output voltage is.

$$V_{p(out)} = 125V - 0.7V$$

$$= 124.3V$$