DIODA APPLICATION

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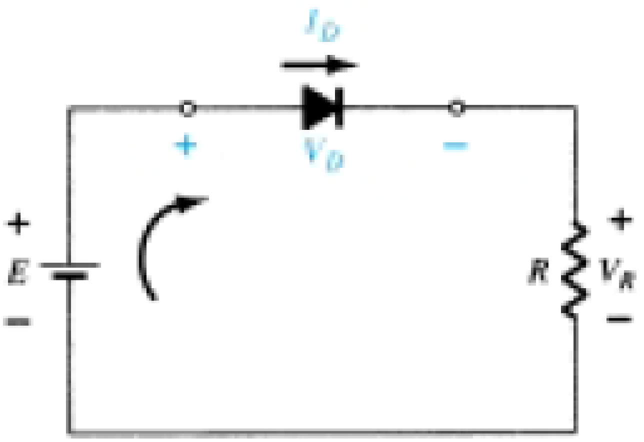
GARIS BEBAN DAN TITIK OPERASI DIODA



$$E - V_D - V_R = 0$$

$$\boxed{E = V_D + I_D R}$$

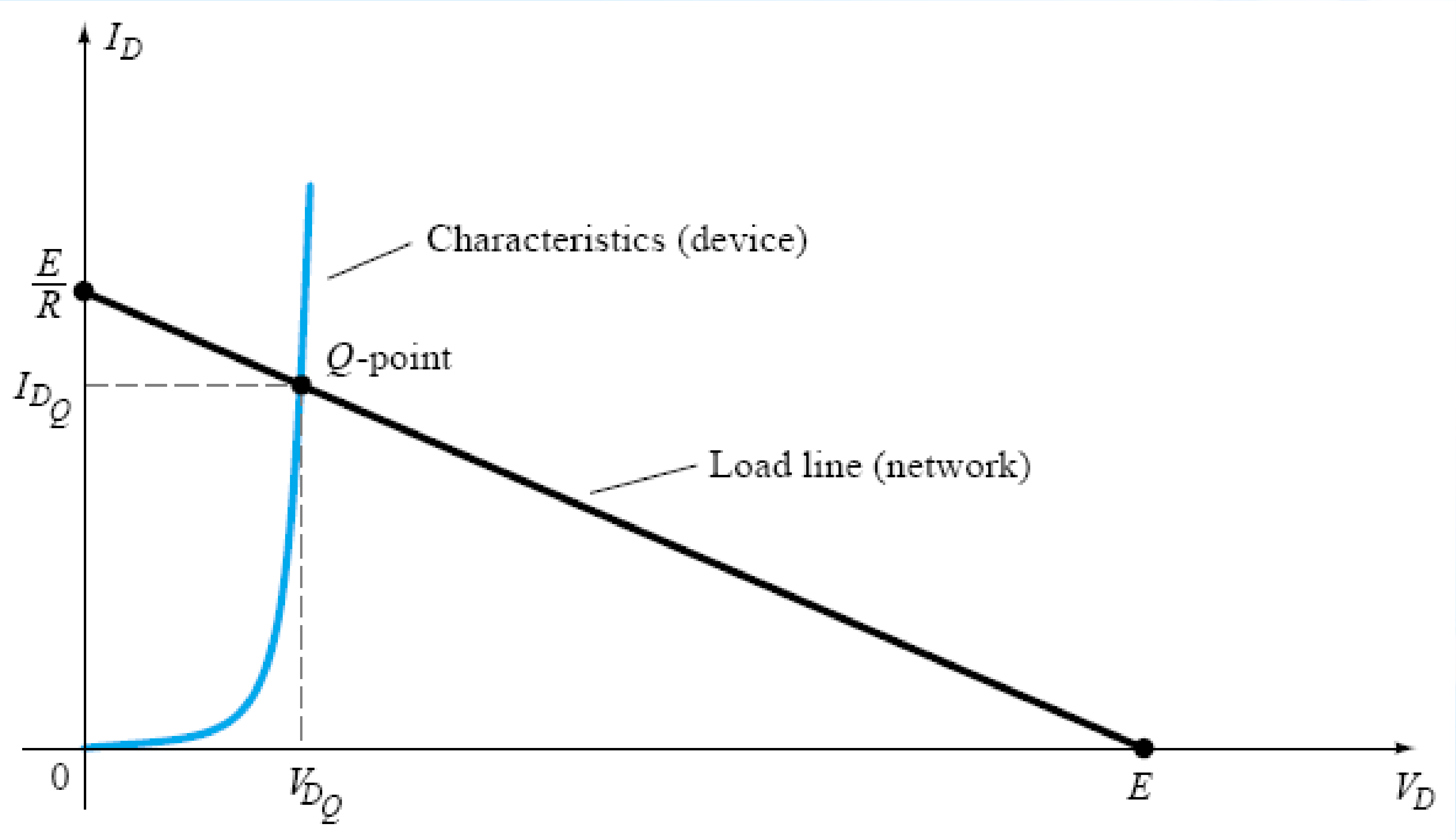
Saat Vd = 0 ➔ Titik Jenuh (Saturation Point)

$$E = V_D + I_D R$$
$$= 0\ \text{V} + I_D R$$
$$\boxed{I_D = \frac{E}{R}\bigg|_{V_D = 0\ \text{V}}}$$

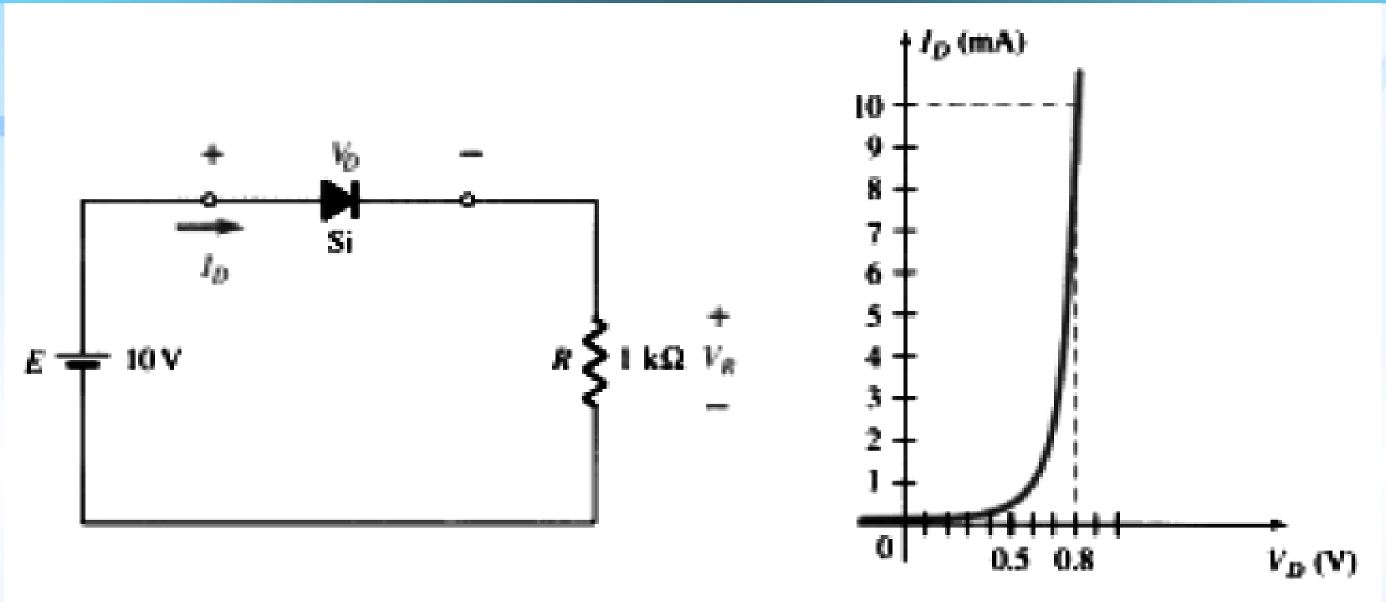
Saat $I_D = 0$ ➔ Titik Putus (Cut Off Point)

$$E = V_D + I_D R$$
$$= V_D + (0\ \text{A})R$$
$$\boxed{V_D = E\big|_{I_D = 0\ A}}$$

GARIS BEBAN DAN TITIK OPERASI



GARIS BEBAN DAN TITIK OPERASI DIODA



- Tentukan :
  - V_{DQ} dan I_{DQ}.
  - V_R.

GARIS BEBAN DAN TITIK OPERASI DIODA

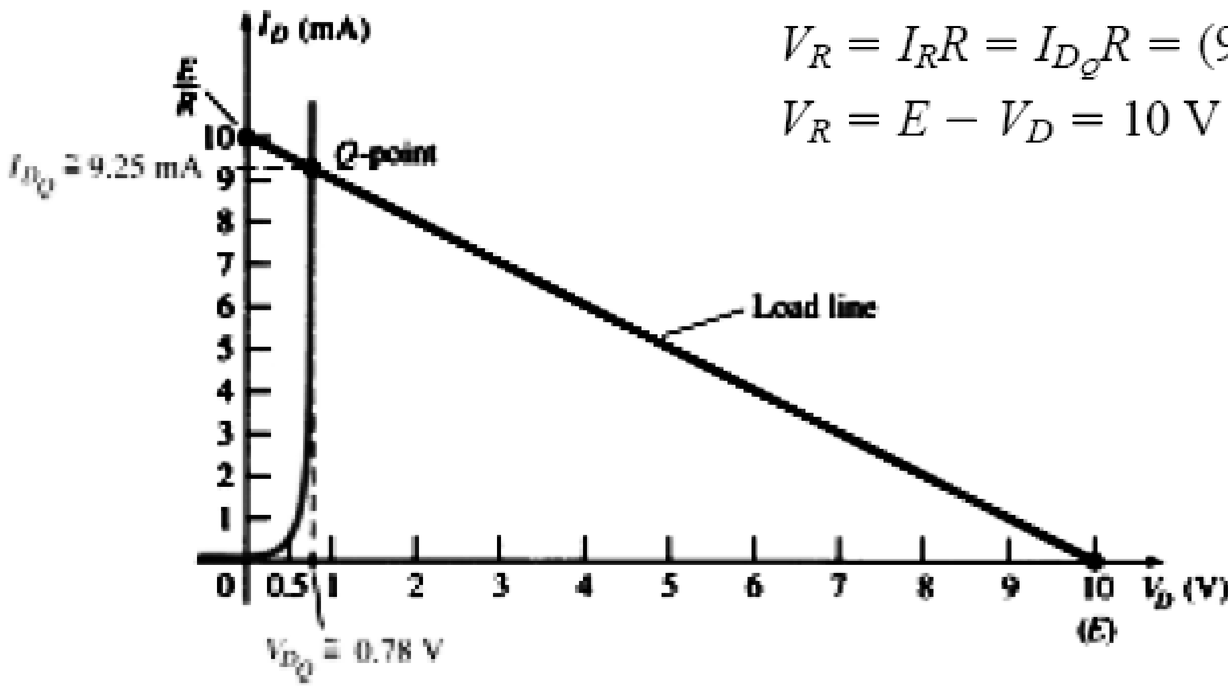
- Solusi

$$I_D = \left.\frac{E}{R}\right|_{V_D = 0\text{ V}} = \frac{10\text{ V}}{2\text{ k}\Omega} = 10\text{ mA}$$

$$V_D = E|_{I_D = 0\text{ A}} = 10\text{ V}$$

$$V_{D_Q} \cong \mathbf{0.78\ V}$$

$$I_{D_Q} \cong \mathbf{9.25\ mA}$$



$$V_R = I_R R = I_{D_Q} R = (9.25\text{ mA})(1\text{ k}\Omega) = \mathbf{9.25\ V}$$

$$V_R = E - V_D = 10\text{ V} - 0.78\text{ V} = \mathbf{9.22\ V}$$

GARIS BEBAN DAN TITIK OPERASI DIODA

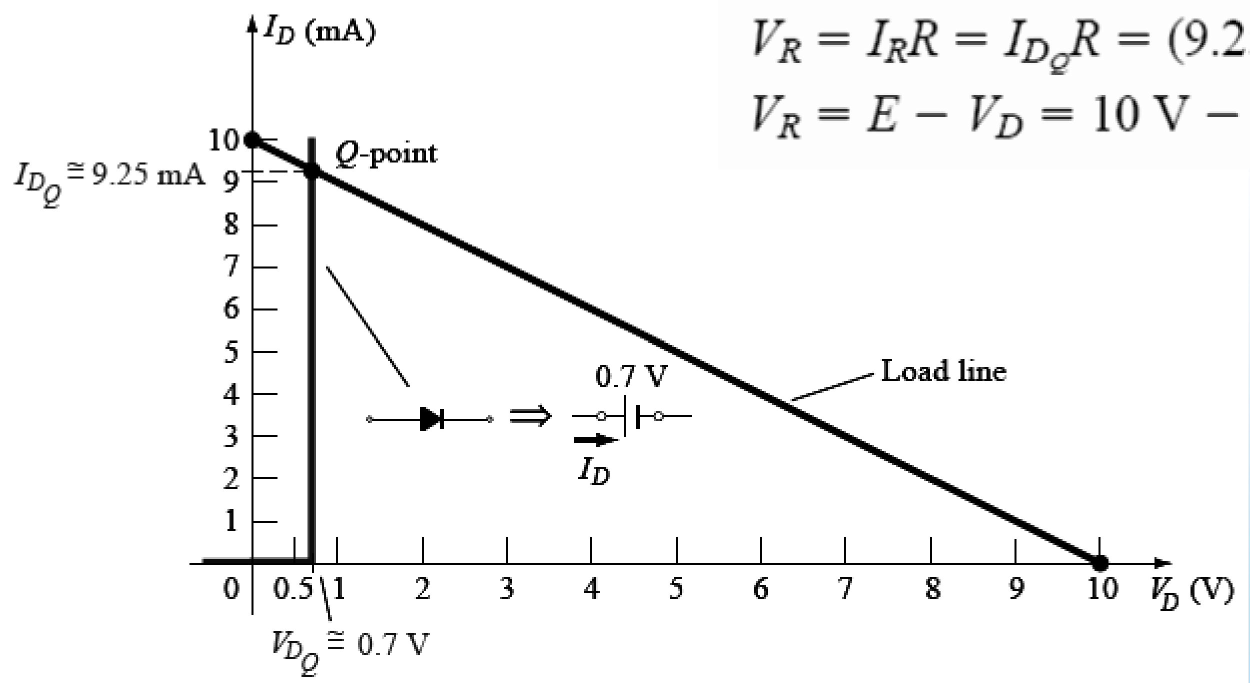
- Jika pendekatannya dengan model dioda sederhana

$$I_D = \left.\frac{E}{R}\right|_{V_D = 0\text{ V}} = \frac{10\text{ V}}{2\text{ k}\Omega} = 10\text{ mA}$$

$$V_D = E|_{I_D = 0\text{ A}} = 10\text{ V}$$

$$V_{D_Q} = \mathbf{0.7\ V}$$

$$I_{D_Q} = \mathbf{9.25\ mA}$$

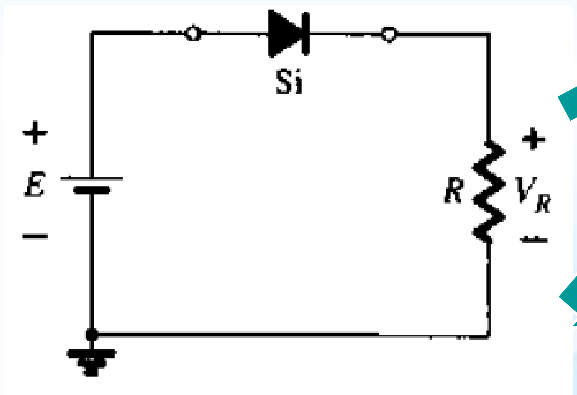


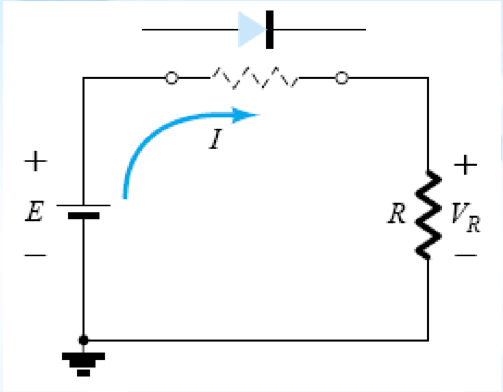
$$V_R = I_R R = I_{D_Q} R = (9.25\text{ mA})(1\text{ k}\Omega) = \mathbf{9.25\ V}$$

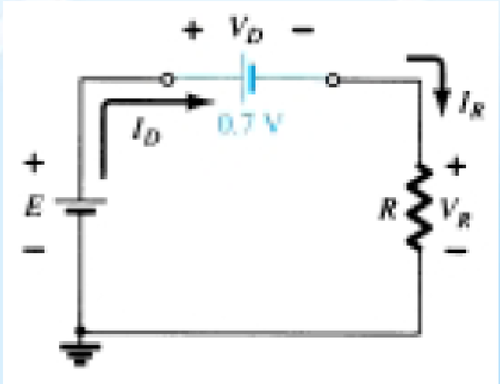
$$V_R = E - V_D = 10\text{ V} - 0.70\text{ V} = \mathbf{9.3\ V}$$

DC INPUT

- Dioda dikatakan dalam kondisi “ON” jika arus I_D dari sumber searah dengan tanda pada sismbol dioda atau forward bias.







$$V_D = V_T$$

$$V_R = E - V_T$$

$$I_D = I_R = \frac{V_R}{R}$$

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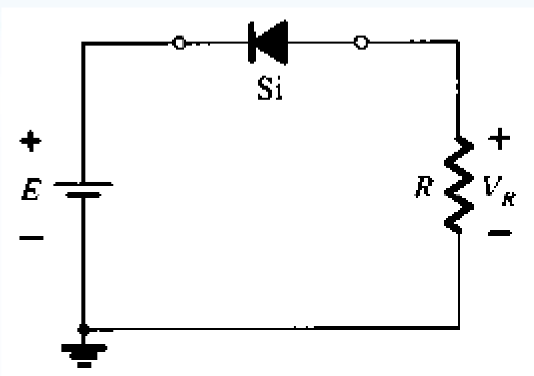
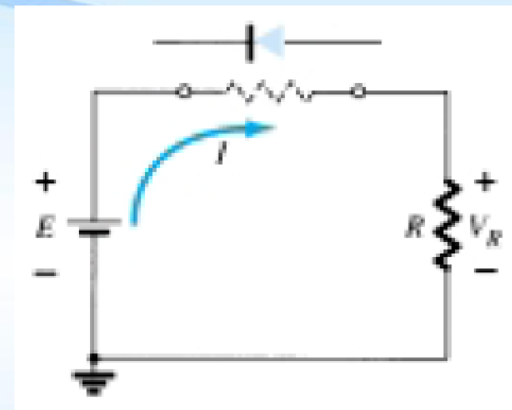
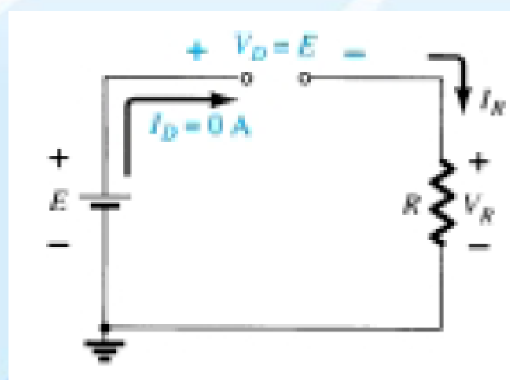
DC INPUT

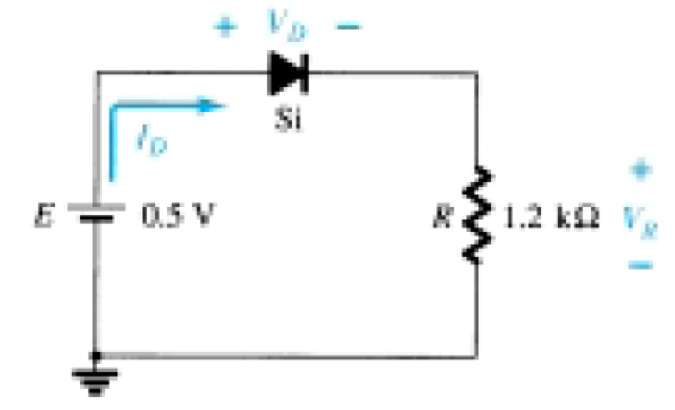
- Dioda dikatakan dalam kondisi "OFF" jika arus I_D dari sumber berlawanan arah dengan tanda pada sismbol dioda atau forward bias.







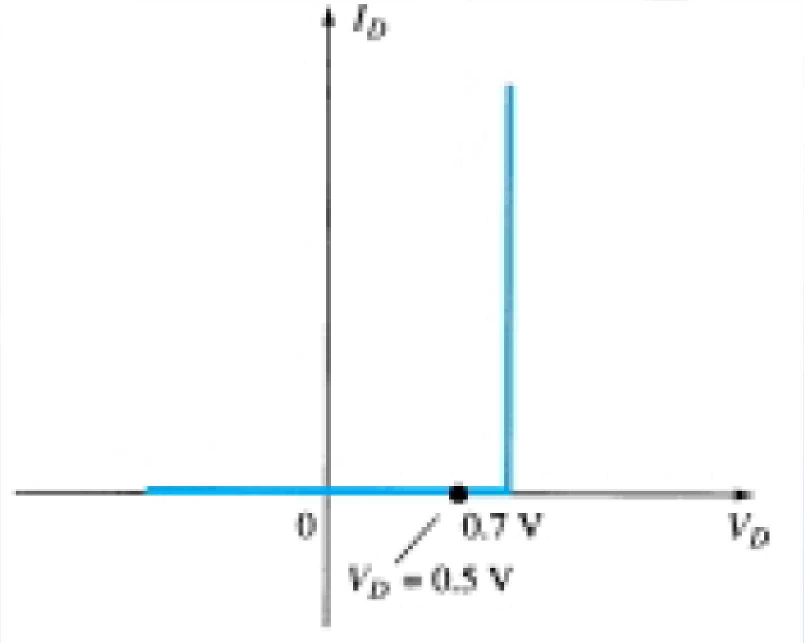
DC INPUT



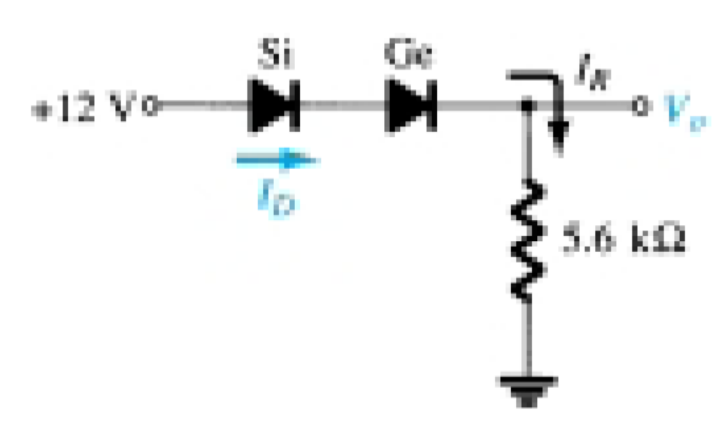
$$I_D = 0 \text{ A}$$

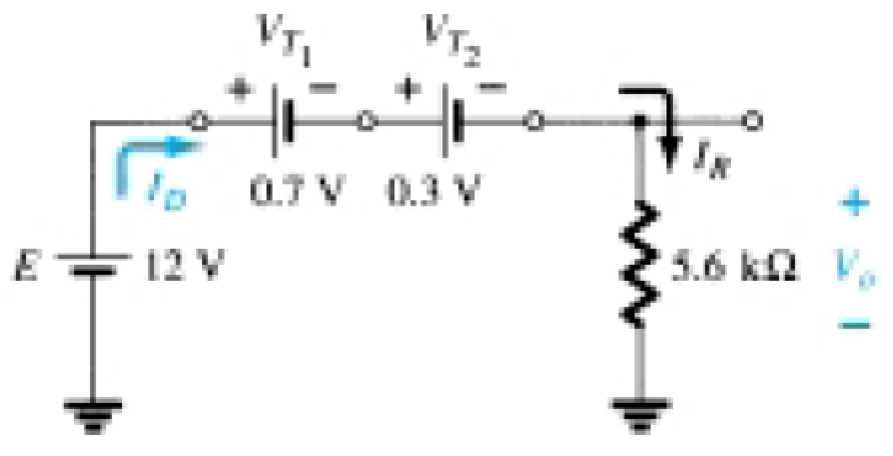
$$V_R = I_R R = I_D R = (0 \text{ A})1.2 \text{ k}\Omega = \mathbf{0 \text{ V}}$$

$$V_D = E = \mathbf{0.5 \text{ V}}$$



DC INPUT

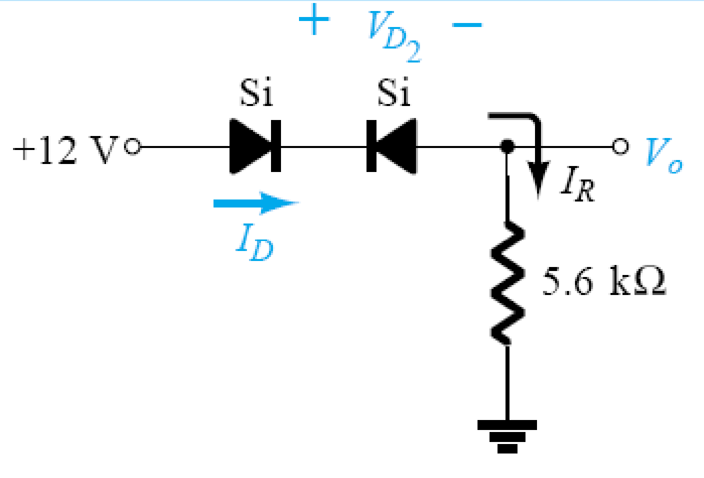


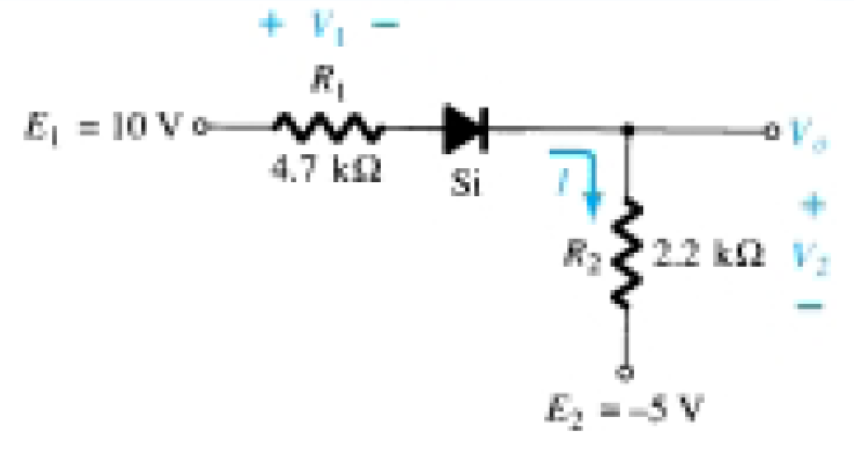


$$V_o = E - V_{T_1} - V_{T_2} = 12\text{ V} - 0.7\text{ V} - 0.3\text{ V} = \mathbf{11\text{ V}}$$

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

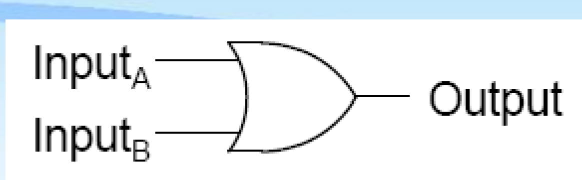
DC INPUT

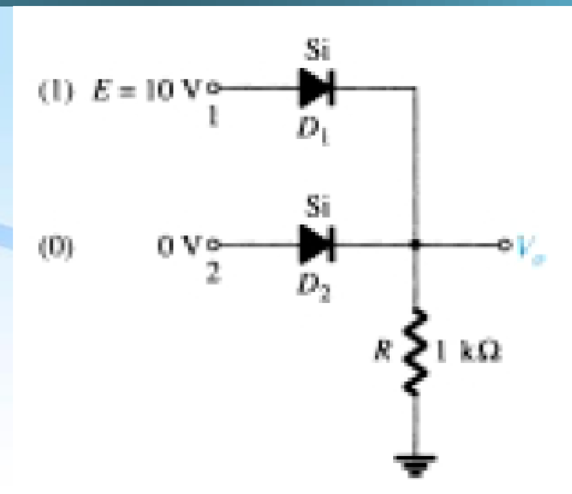

+ V_{D_2} −
Si
Si
+12 V
V_o
I_R
I_D
5.6 kΩ

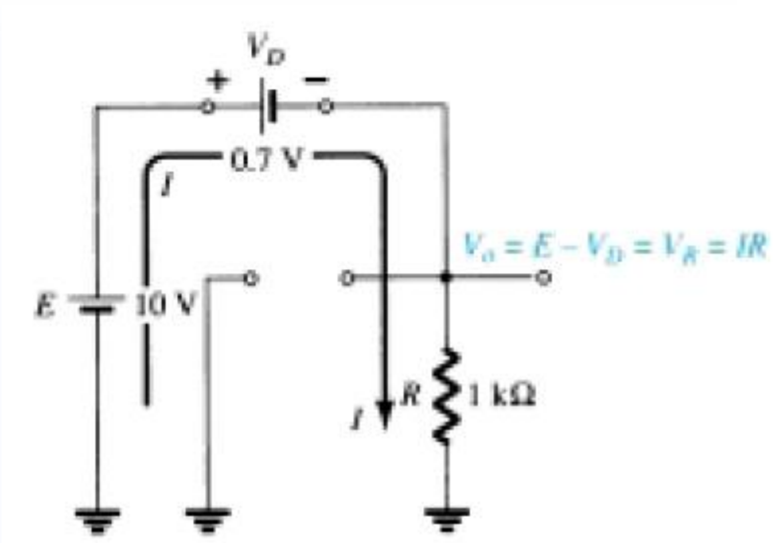

+ V_1 −
R_1
E_1 = 10 V
4.7 kΩ
Si
V_o
I
+
R_2
2.2 kΩ
V_2
−
E_2 = −5 V

PR

OR GATE DENGAN DIODA







$$I = \frac{E - V_D}{R} = \frac{10\text{ V} - 0.7\text{ V}}{1\text{ k}\Omega} = \mathbf{9.3\text{ mA}}$$

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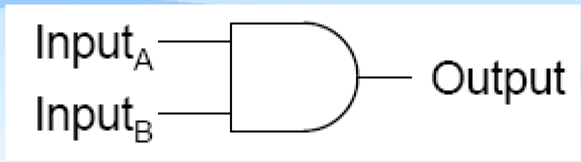
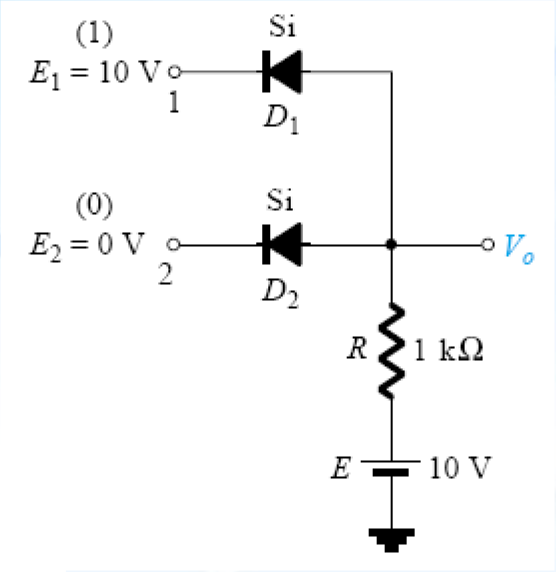
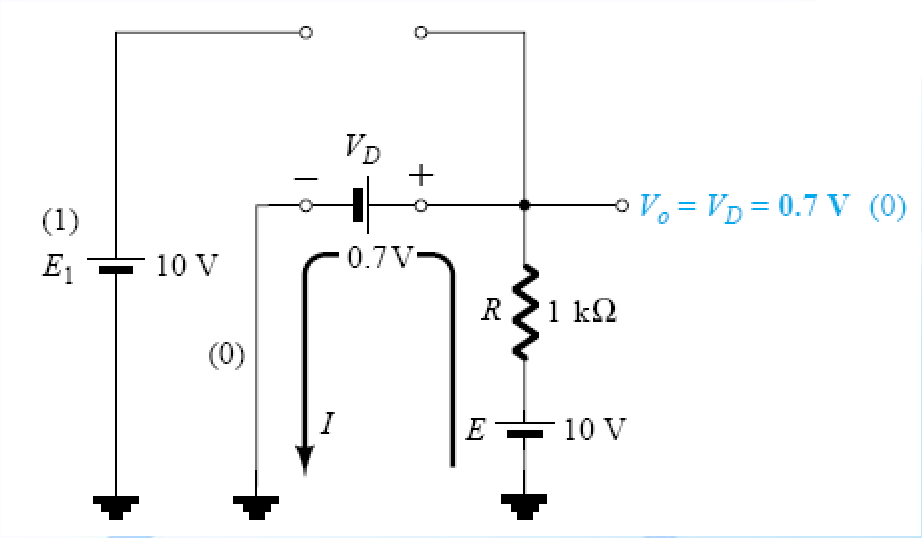
AND GATE DENGAN DIODA

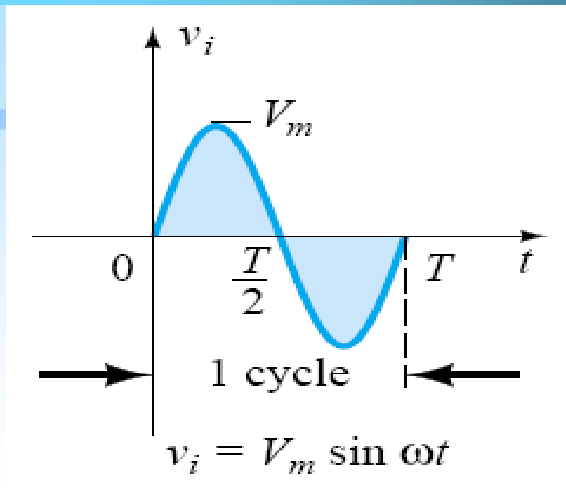


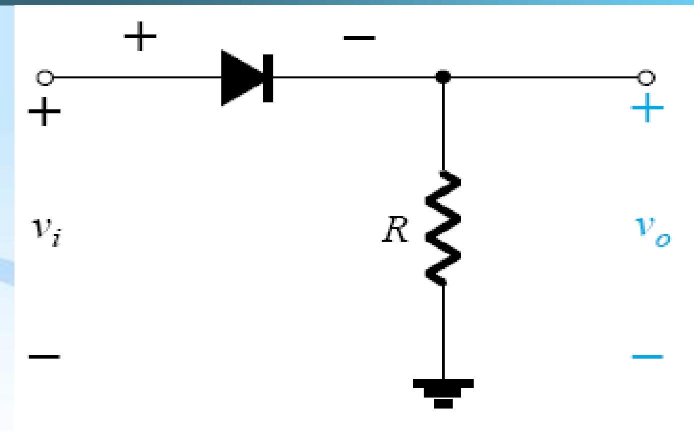




$$I = \frac{E - V_D}{R} = \frac{10\ \text{V} - 0.7\ \text{V}}{1\ \text{k}\Omega} = \mathbf{9.3\ mA}$$

HALF WAVE RECTIFICATION





$$V_{eff} = V_{rms} = \frac{Vm}{\sqrt{2}} = 0.707\ Vm$$

- Tegangan (arus) efektif atau rms (*root-mean-square) adalah tegangan (arus) yang terukur* oleh voltmeter (amper-meter).

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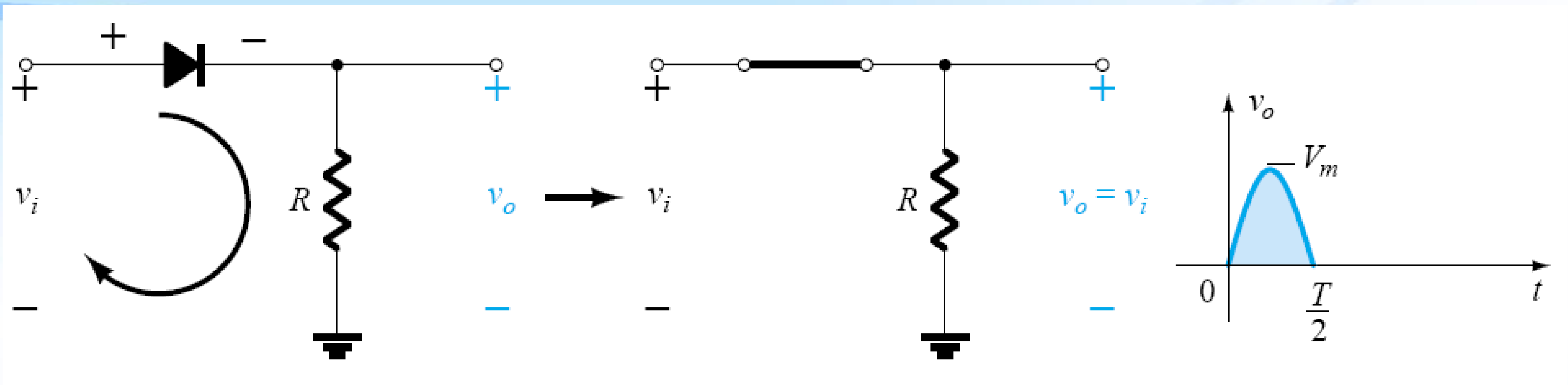
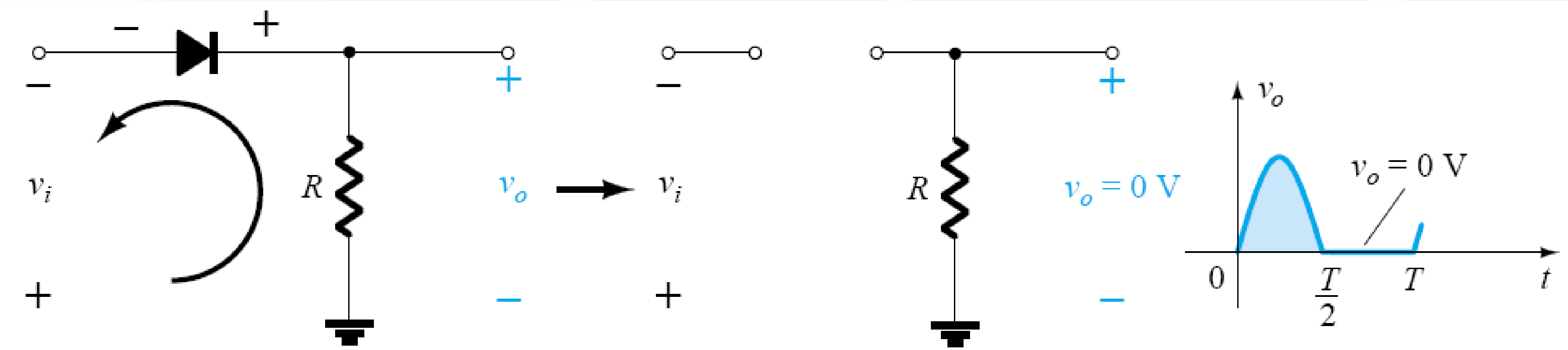
AC INPUT ➔ HALF WAVE RECTIFIER

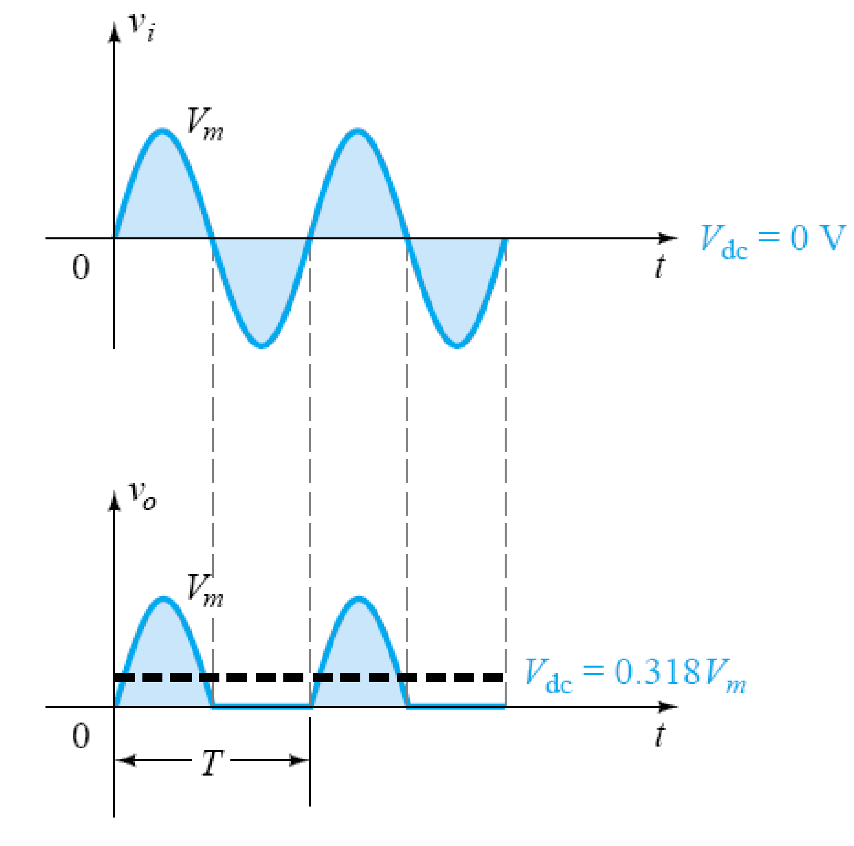
Saat Fase Positif



Saat Fase Negatif



AC INPUT ➔ HALF WAVE RECTIFIER



V_{avg} = Luasan kurva / Perioda

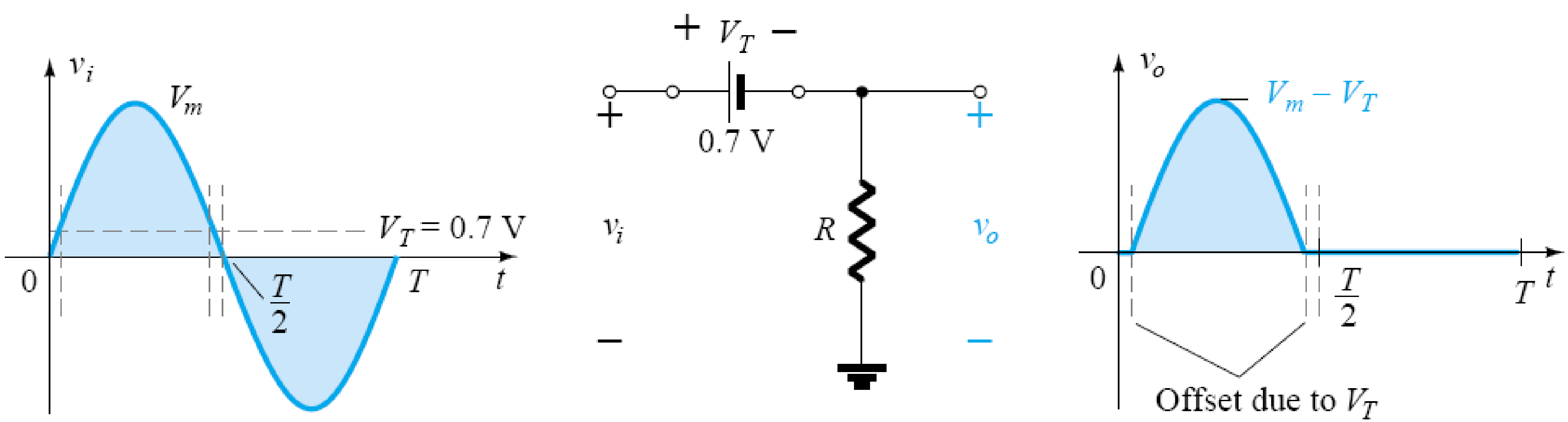
$$\text{area} = \int_0^{\pi} I_m \sin\alpha \, d\alpha = -I_m \cos\alpha \Big[_0^{\pi} = 2I_m$$

$T = 2\pi$

$$I_{avg} = \frac{2I_m}{2\pi} = \frac{I_m}{\pi} = 0.318 I_m$$

$$\boxed{V_{dc} = 0.318 V_m}$$

AC INPUT ➔ HALF WAVE RECTIFIER



$$\boxed{V_{dc} \cong 0.318(V_m - V_T)}$$

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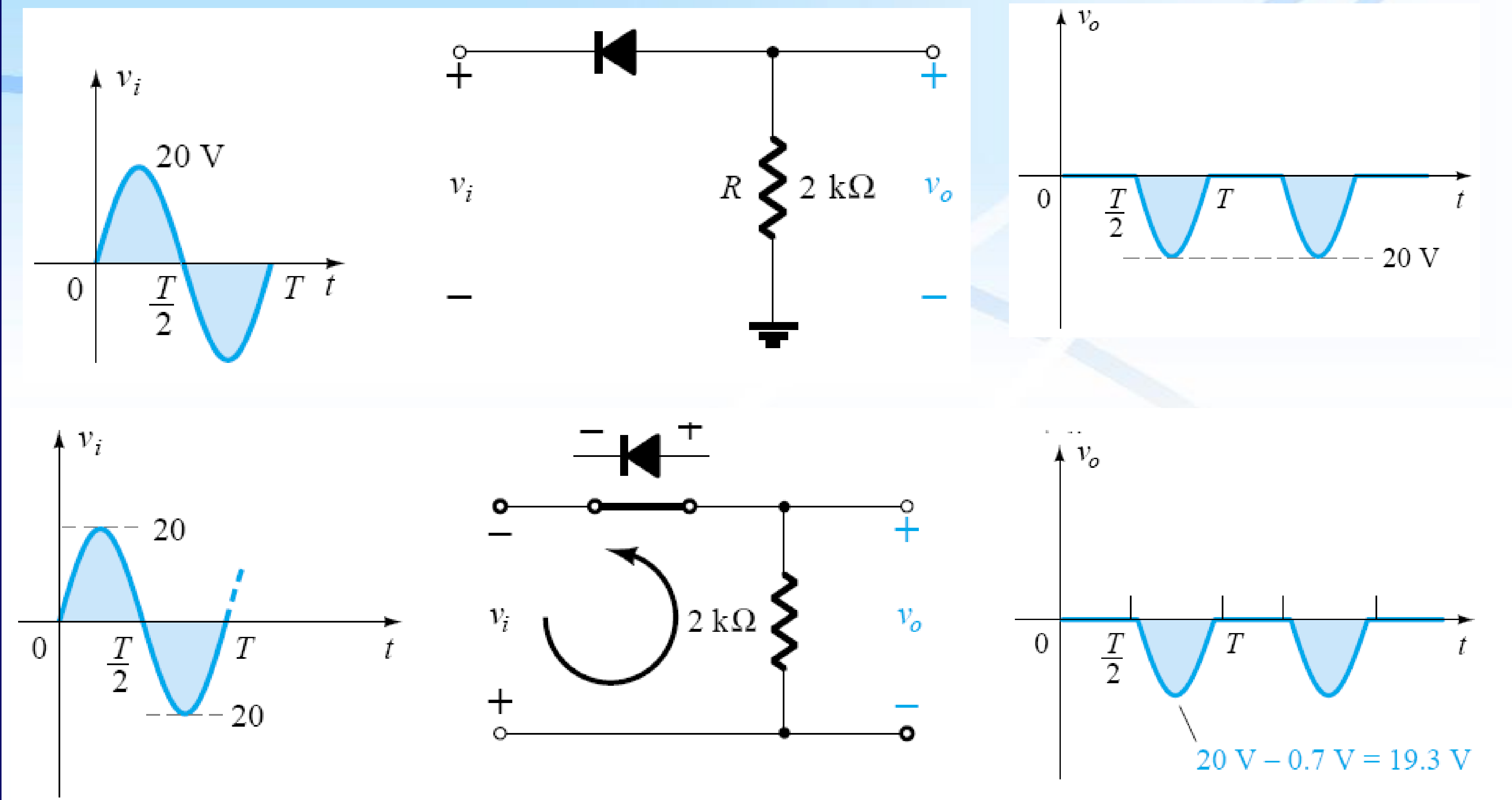
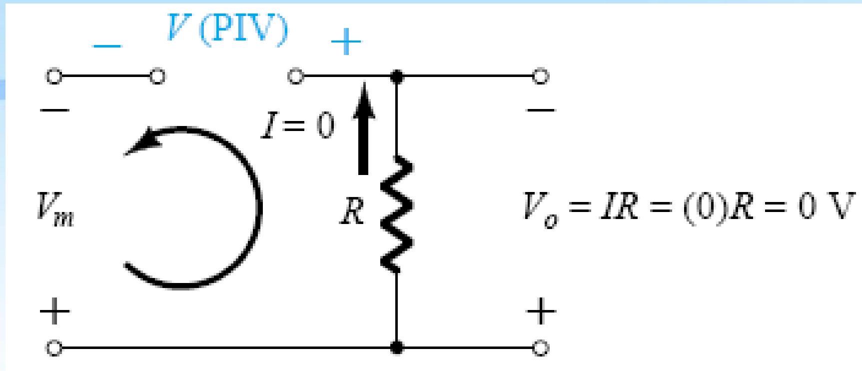
AC INPUT ➔ HALF WAVE RECTIFIER



$$V_{dc} \cong -0.318(V_m - 0.7\text{ V}) = -0.318(19.3\text{ V}) \cong \mathbf{-6.14\ V}$$

PEAK INVERSE VOLTAGE (PIV)

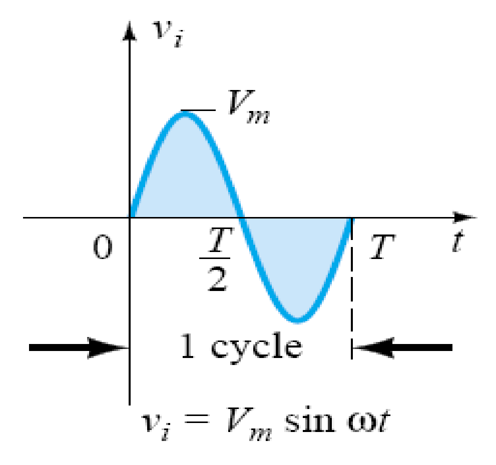


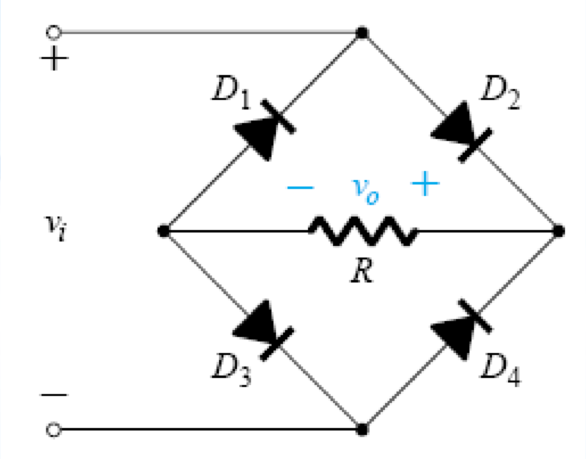
$$\text{PIV rating} \geqq V_m$$

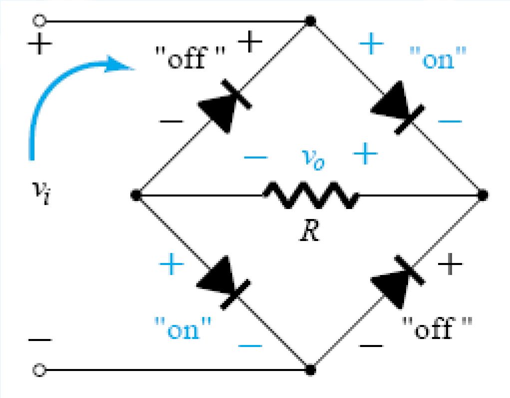
- PIV (*peak-inverse voltage*) atau tegangan puncak balik adalah Tegangan maksimum yang harus ditahan oleh dioda.
- Karena pada saat dioda mendapat bias mundur (balik) maka tidak ada arus yang mengalir dan semua tegangan dari sumber berada pada dioda.

FULL-WAVE RECTIFICATION

Bridge Network

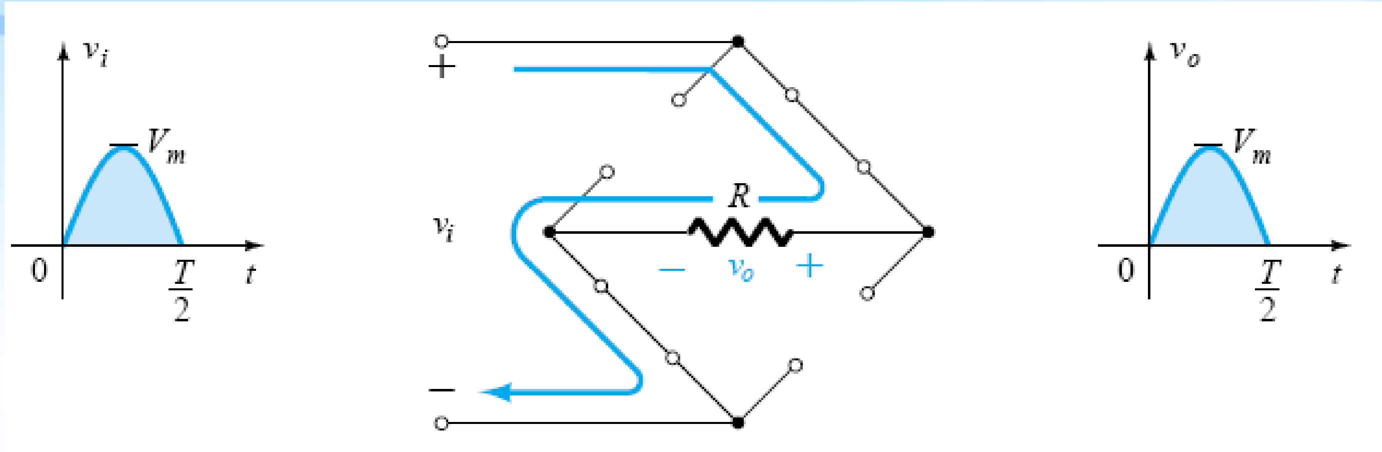




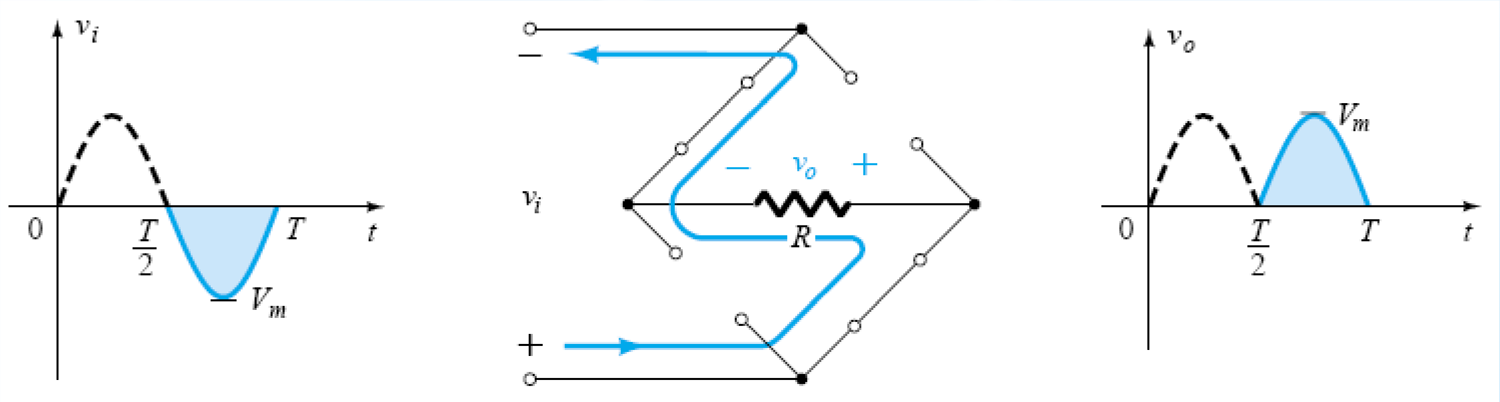


FWR ➔ BRIDGE NETWORK

FASE POSITIF



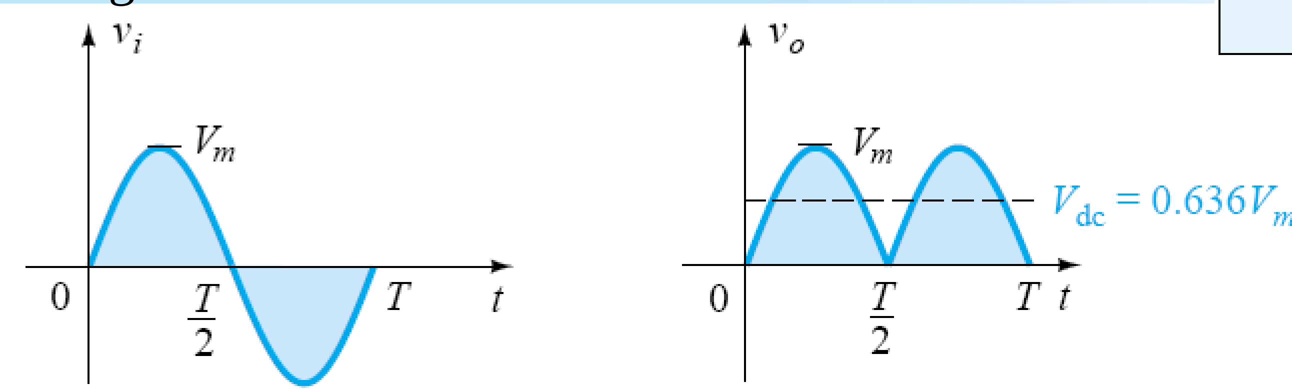
FASE NEGATIF



FWR ➔ BRIDGE NETWORK

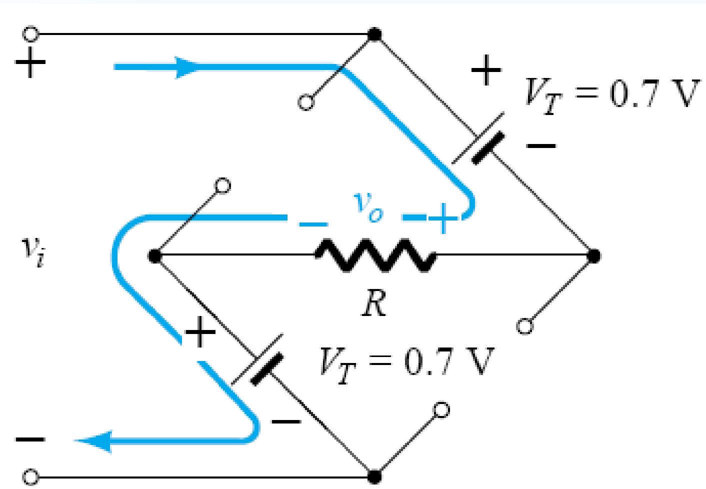
Dengan Pendekatan Dioda Ideal

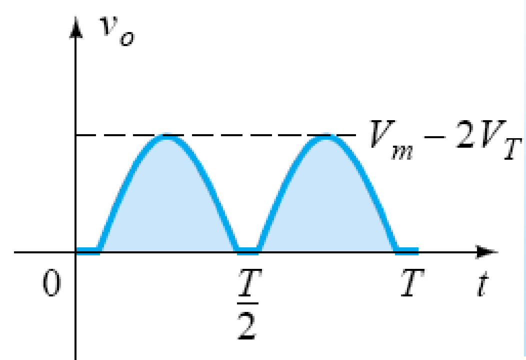
$$V_{dc} = 0.636 V_m$$



$$\text{PIV} \geqq V_m$$

Dengan Pendekatan Dioda Sederhana





$$V_{dc} \cong 0.636(V_m - 2V_T)$$

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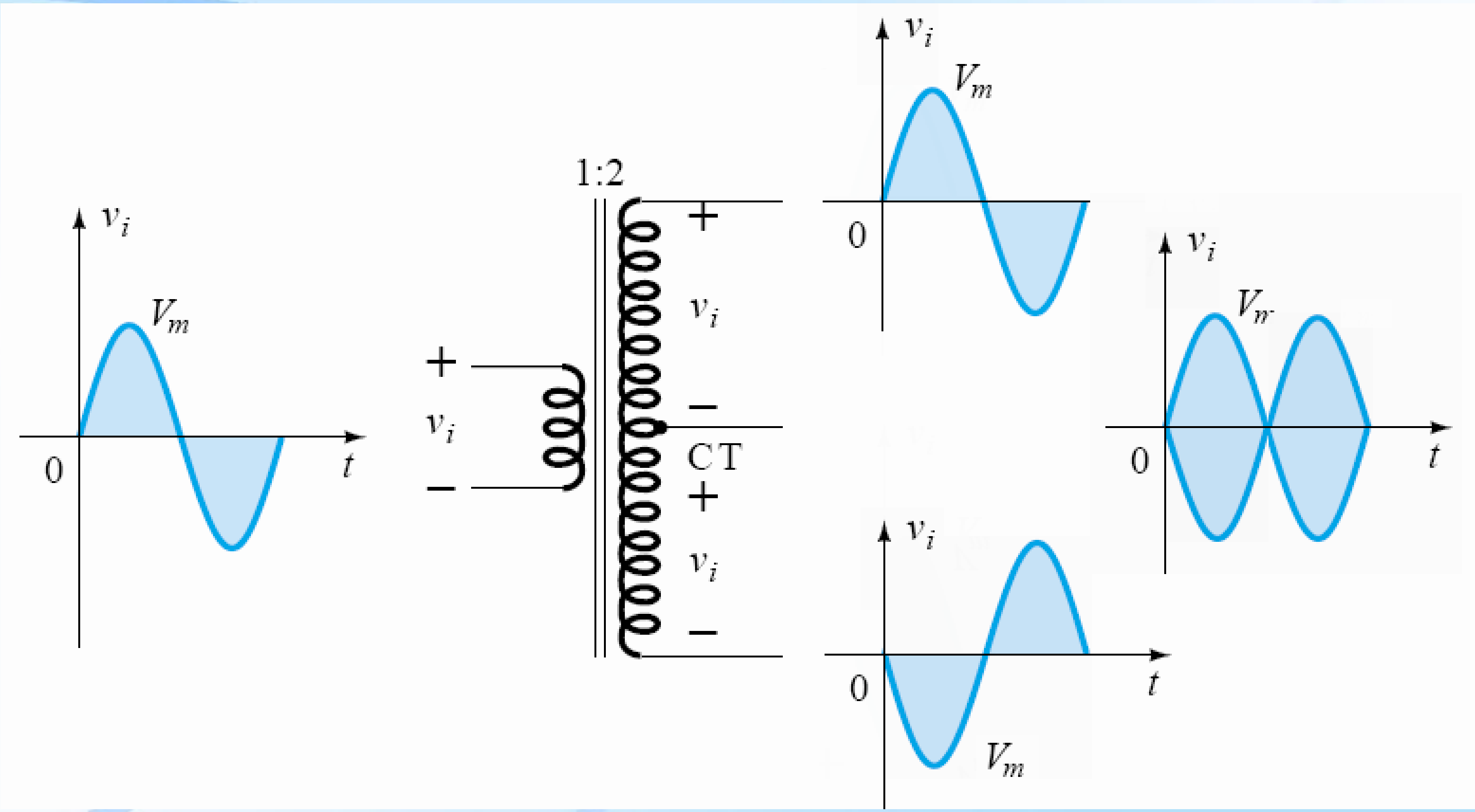
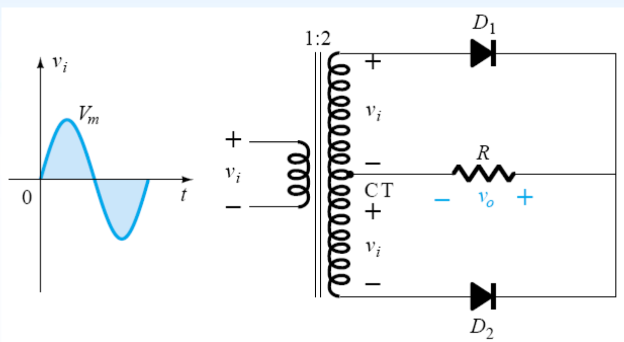
FULL-WAVE RECTIFICATION

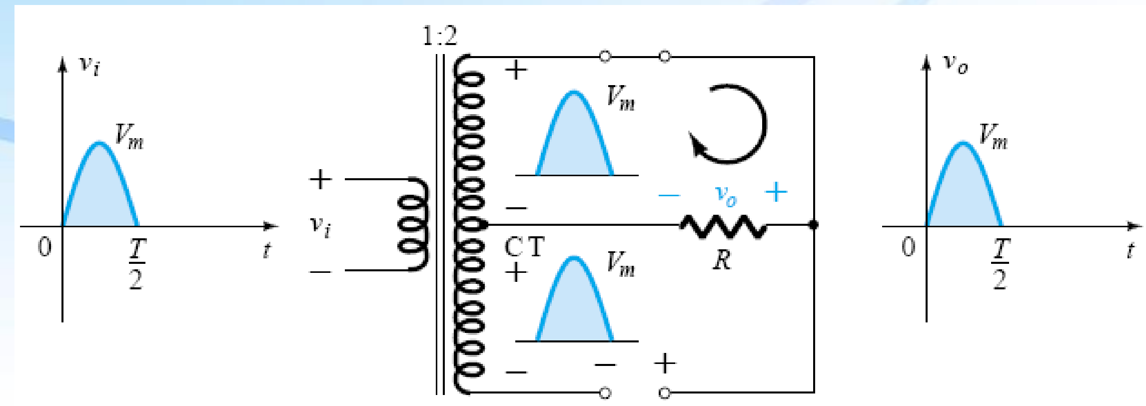
Center-Tapped Transformer



FWR➔ CENTER-TAPPED TRANSFORMER

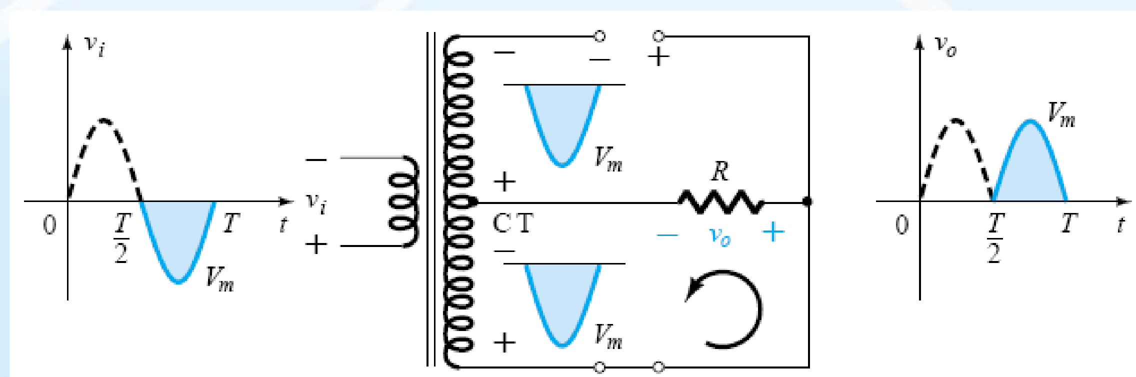


FASE POSITIF



$$\text{PIV} \geqq 2V_m$$

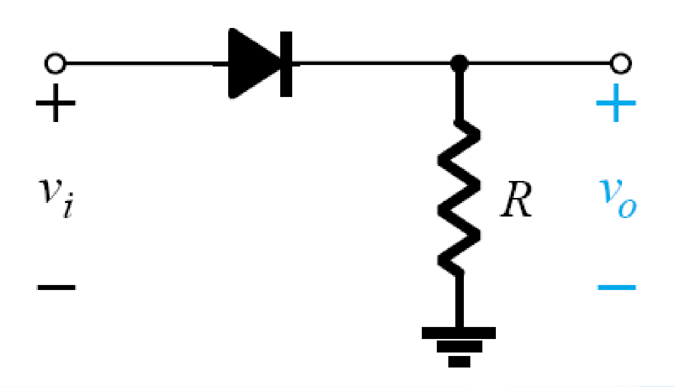
FASE NEGATIF

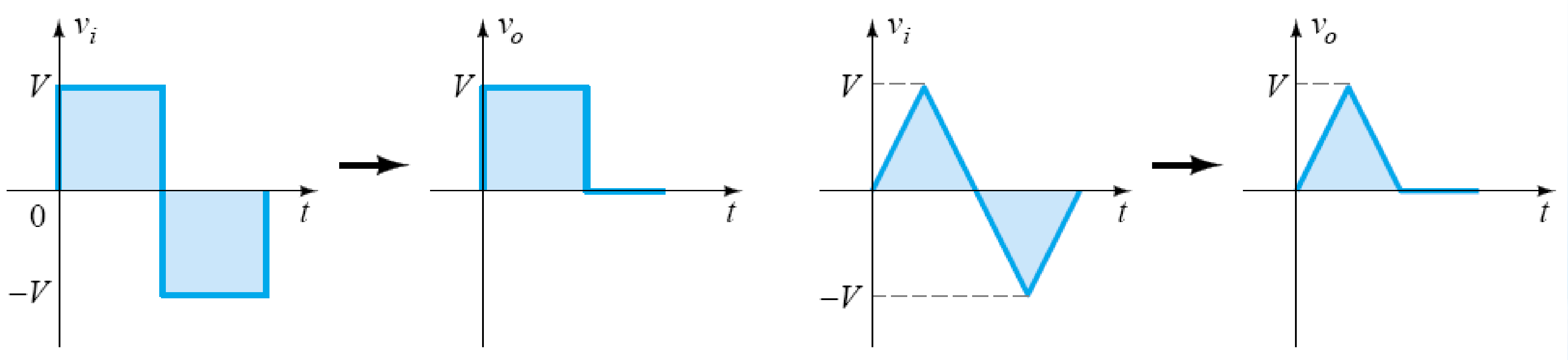


CLIPPER

- Rangkaian clipper (pemotong) digunakan untuk memotong atau menghilangkan sebagian sinyal masukan yang berada di bawah atau di atas level tertentu.
- Rangkaian Clipper ada 2 : Seri dan Paralel
- Rangkaian clipper seri berarti diodanya berhubungan secara seri dengan beban,
- Rangkaian Clipper paralel berarti diodanya dipasang paralel dengan beban.

SERIES CLIPPER





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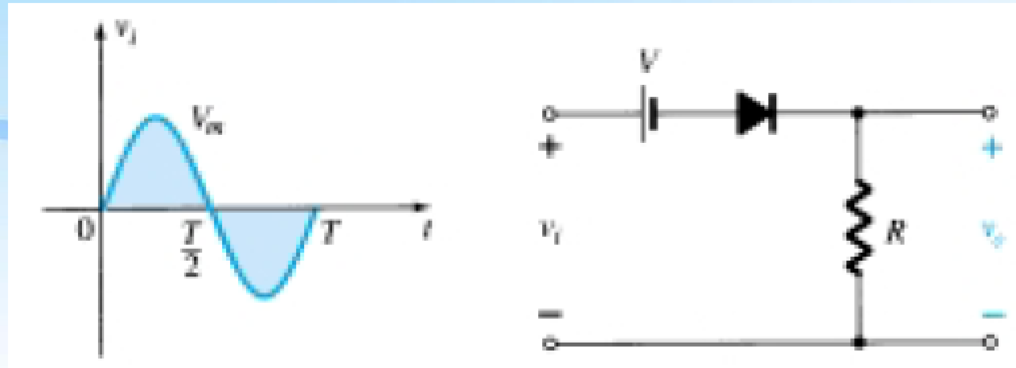

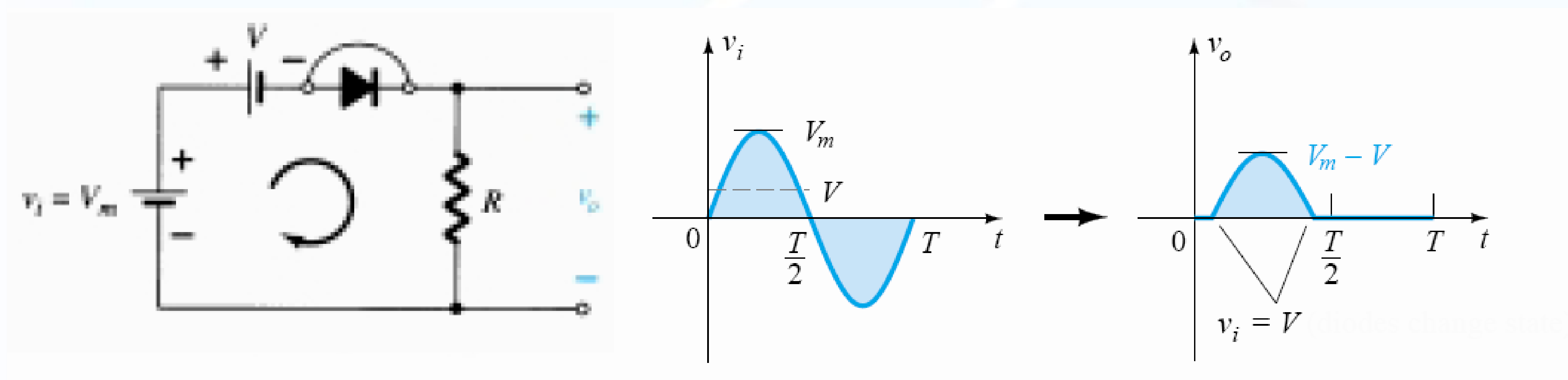

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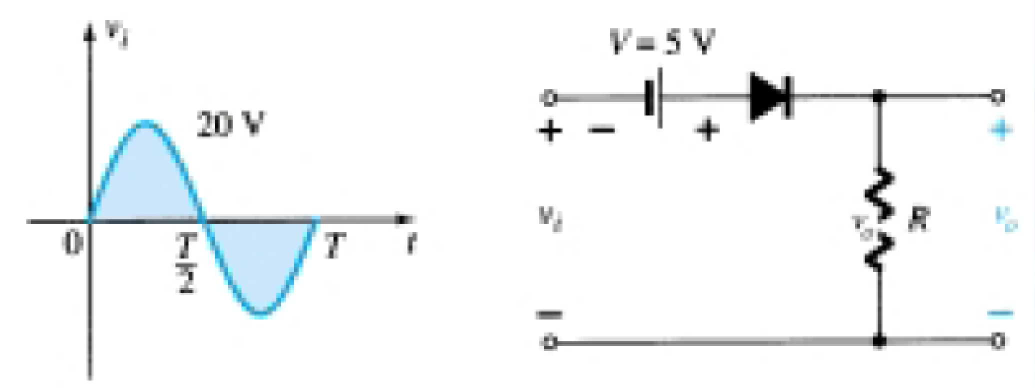

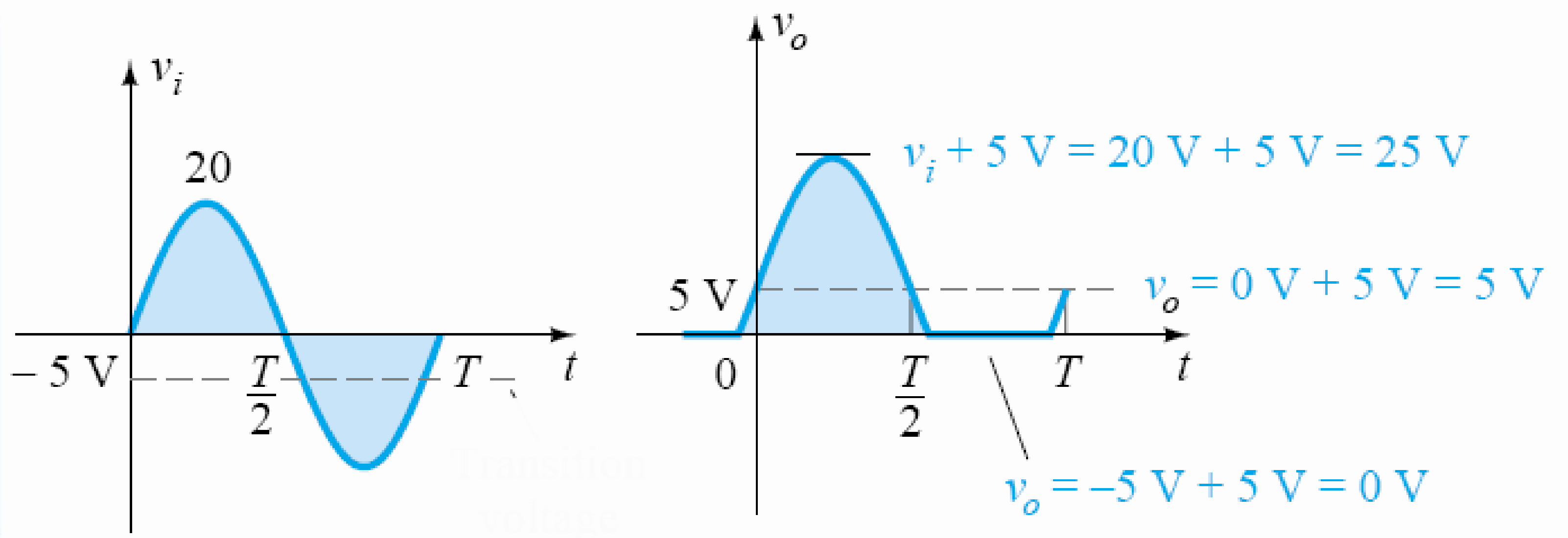

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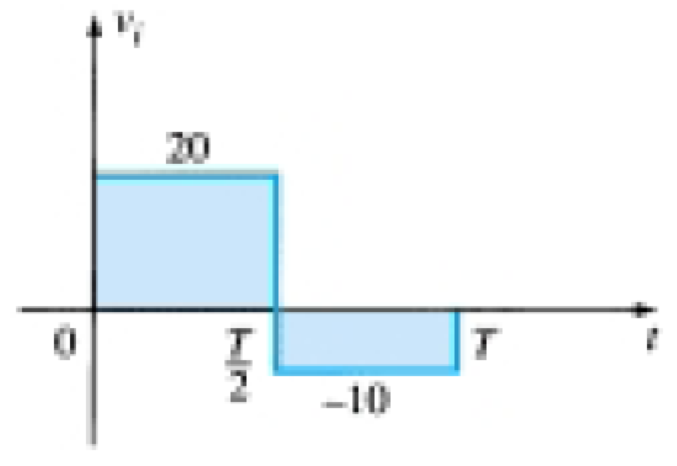

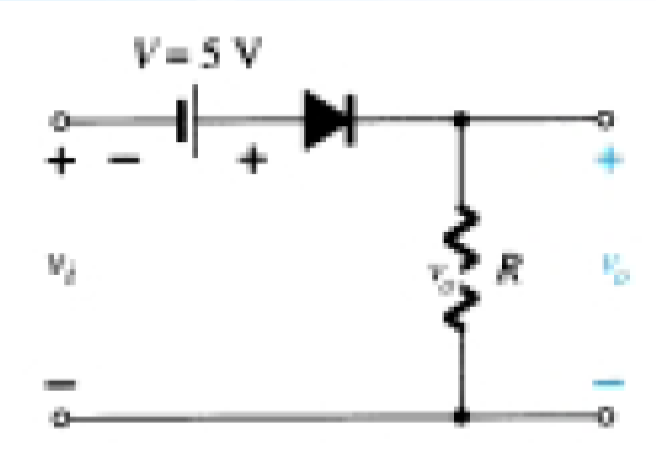

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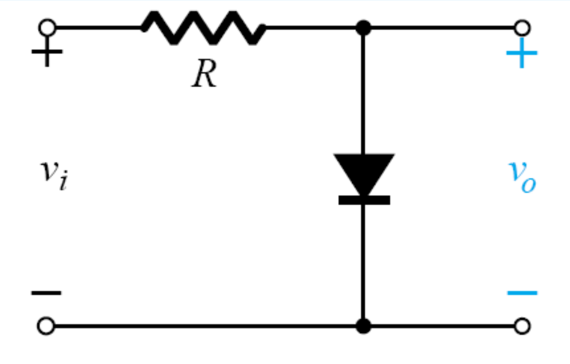
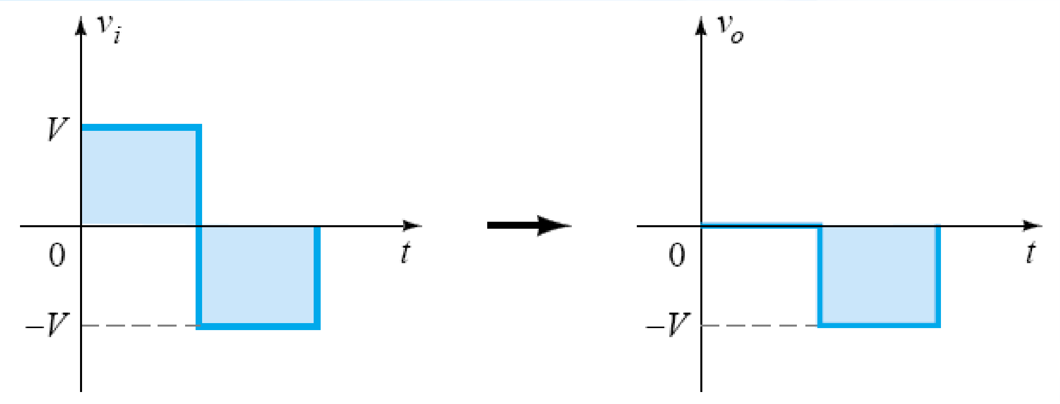
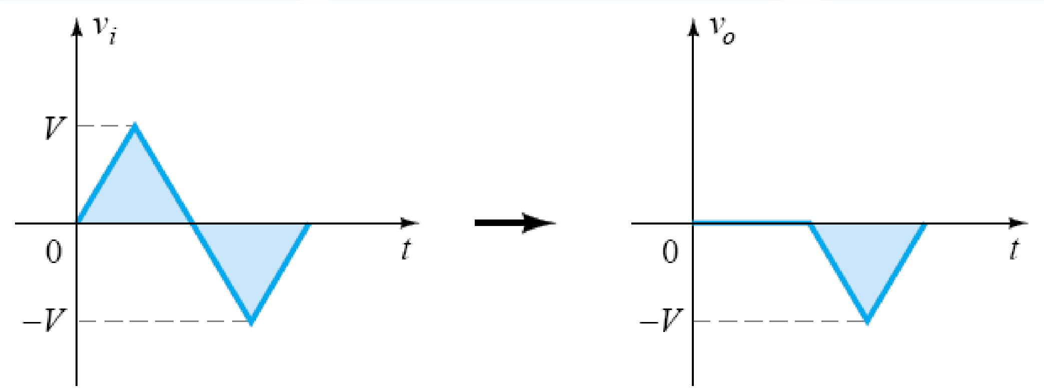
PARALEL CLIPPER

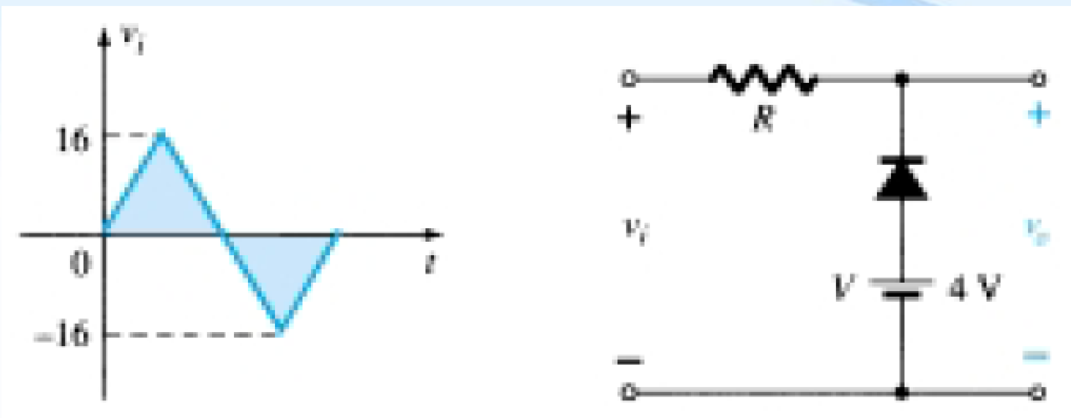
PENDEKATAN DENGAN DIODA IDEAL

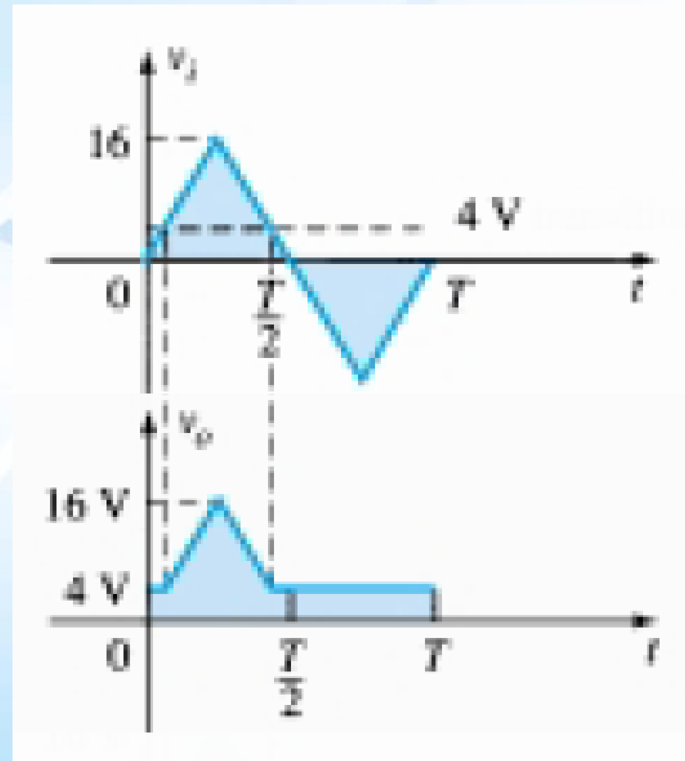






PARALEL CLIPPER

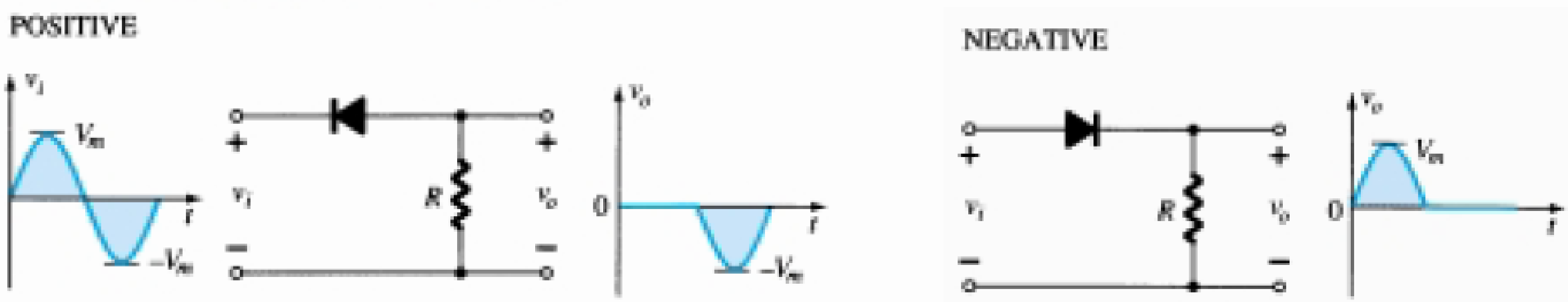




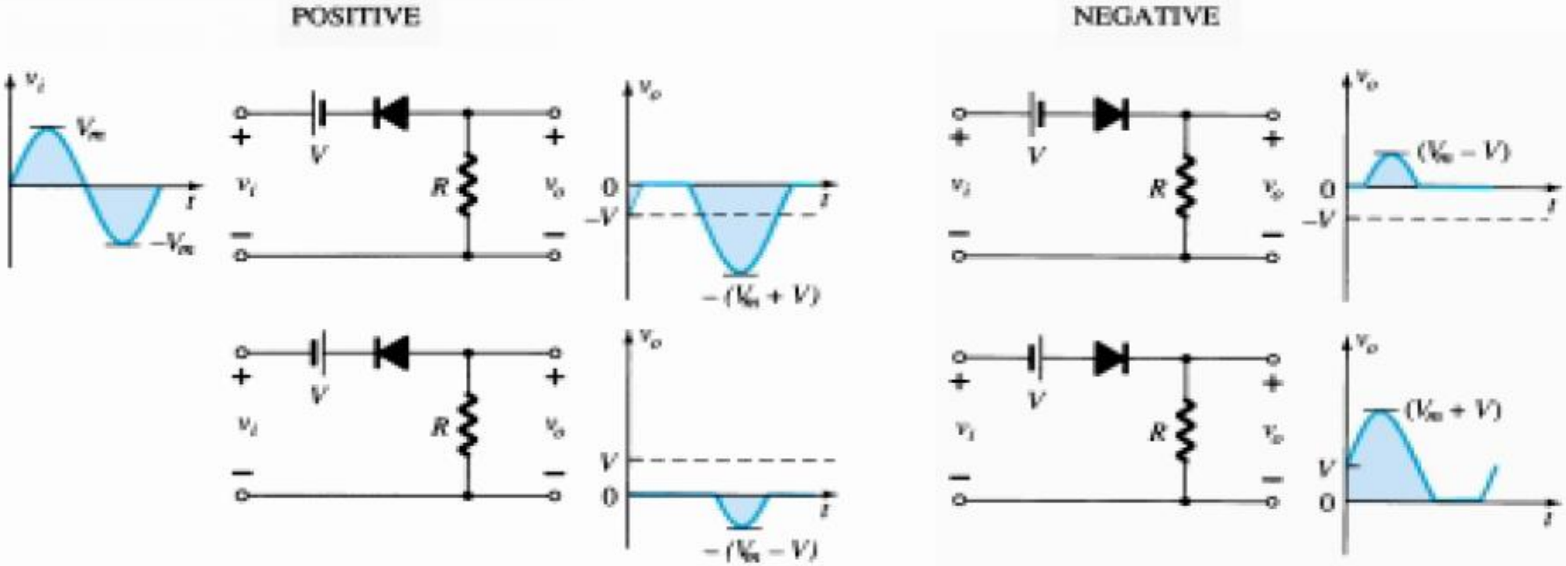
mas.suwito@gmail.com

CLIPPER

Simple Series Clippers (Ideal Diodes)



Biased Series Clippers (Ideal Diodes)



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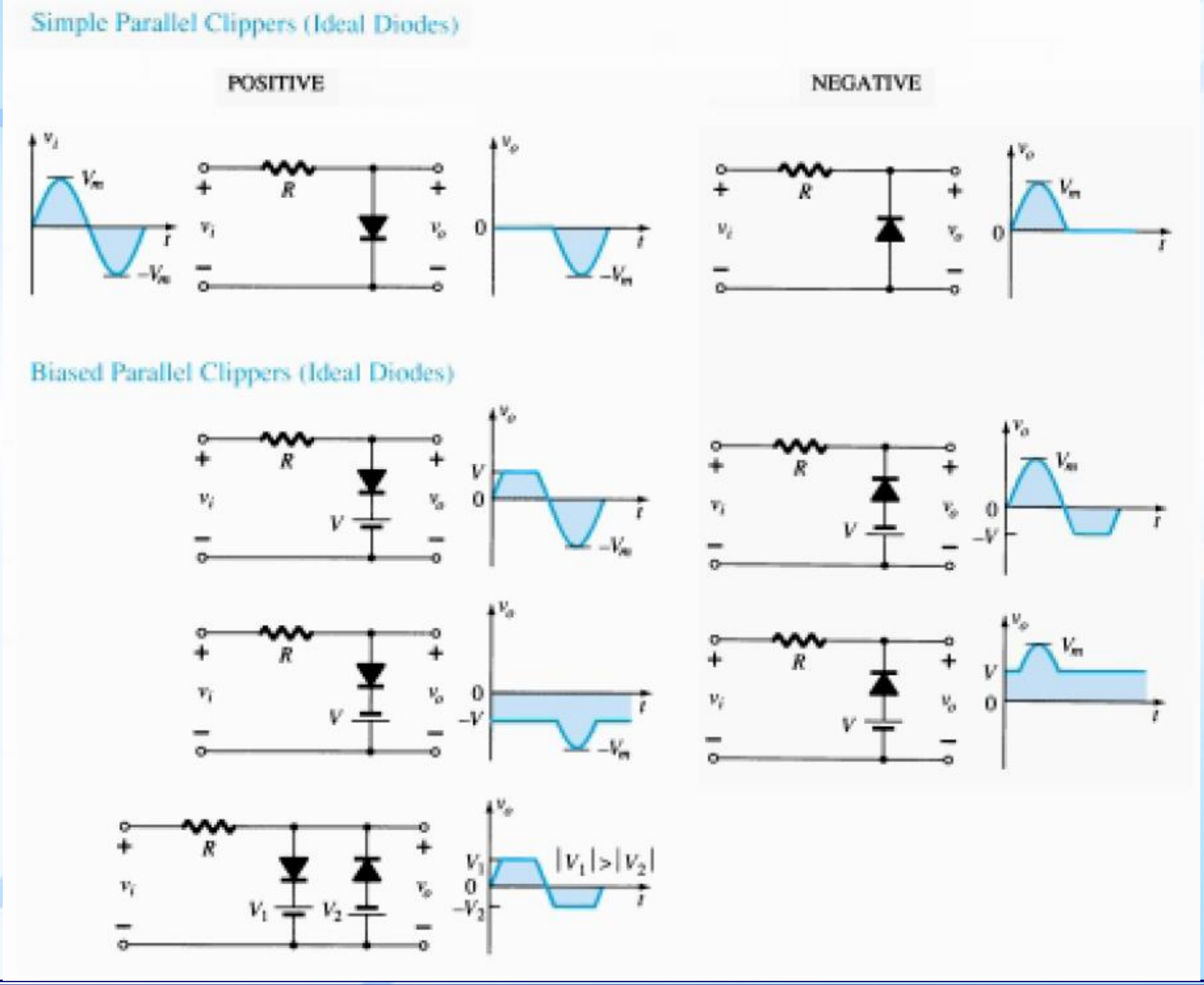

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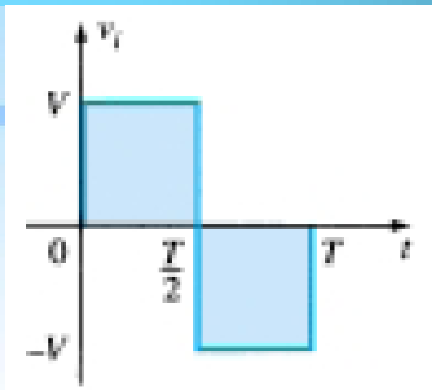
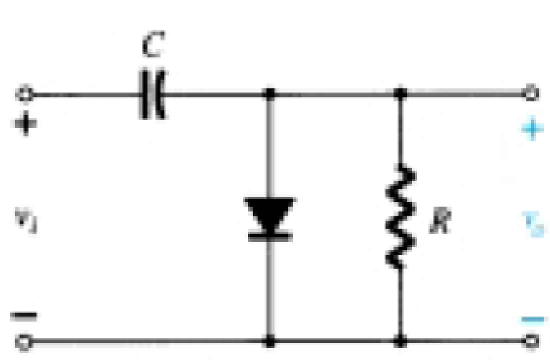
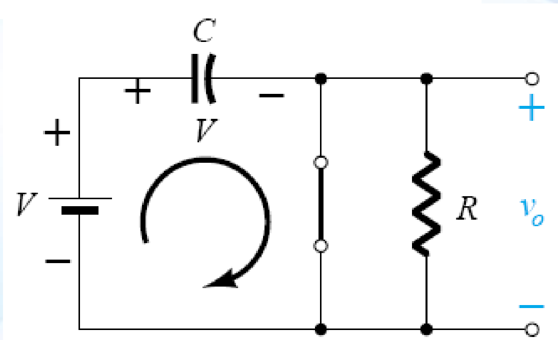




$0 \rightarrow T/2$

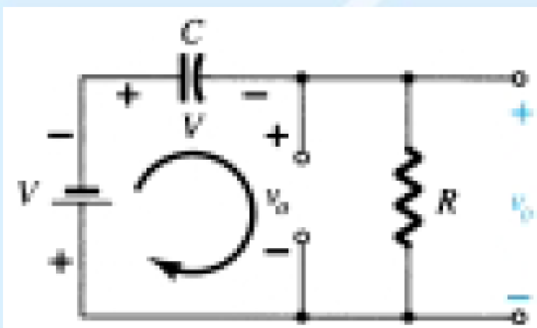
$v_o = 0$ V.

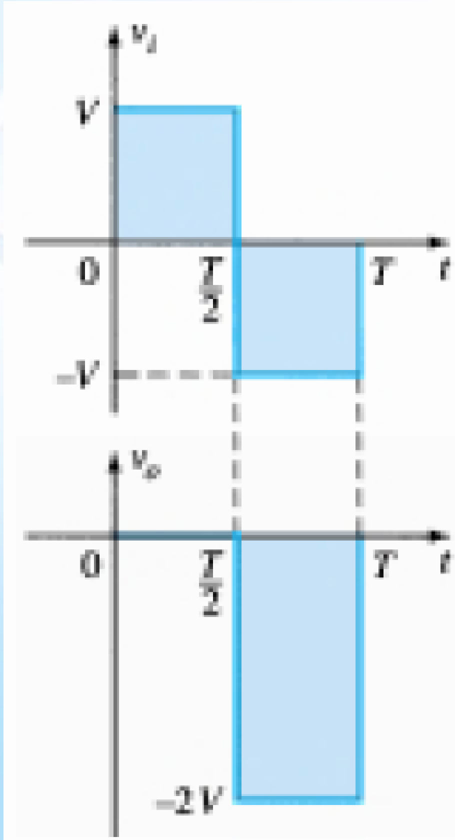


$T/2 \rightarrow T,$

$$-V - V - v_o = 0$$

$$v_o = -2V$$





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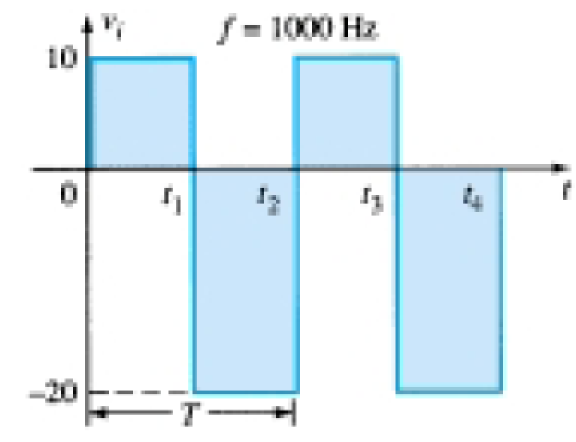

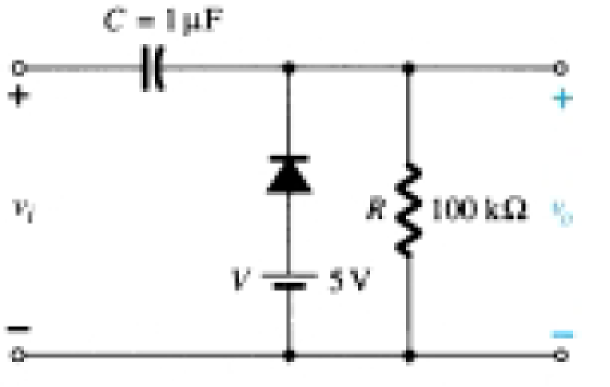

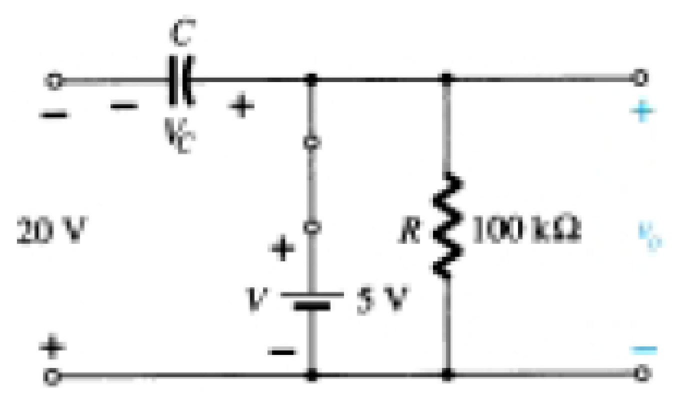

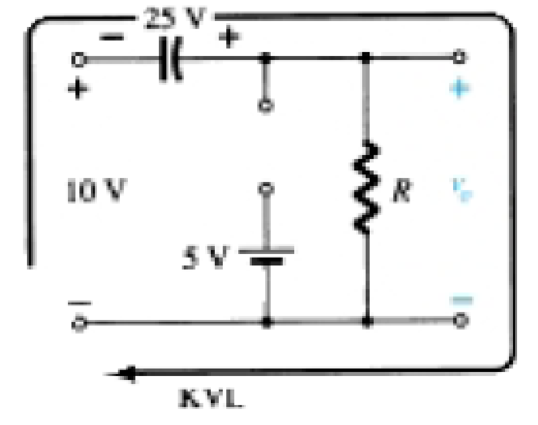

$$-20\text{ V} + V_C - 5\text{ V} = 0$$
$$V_C = 25\text{ V}$$

$$+10\text{ V} + 25\text{ V} - v_o = 0$$
$$v_o = 35\text{ V}$$

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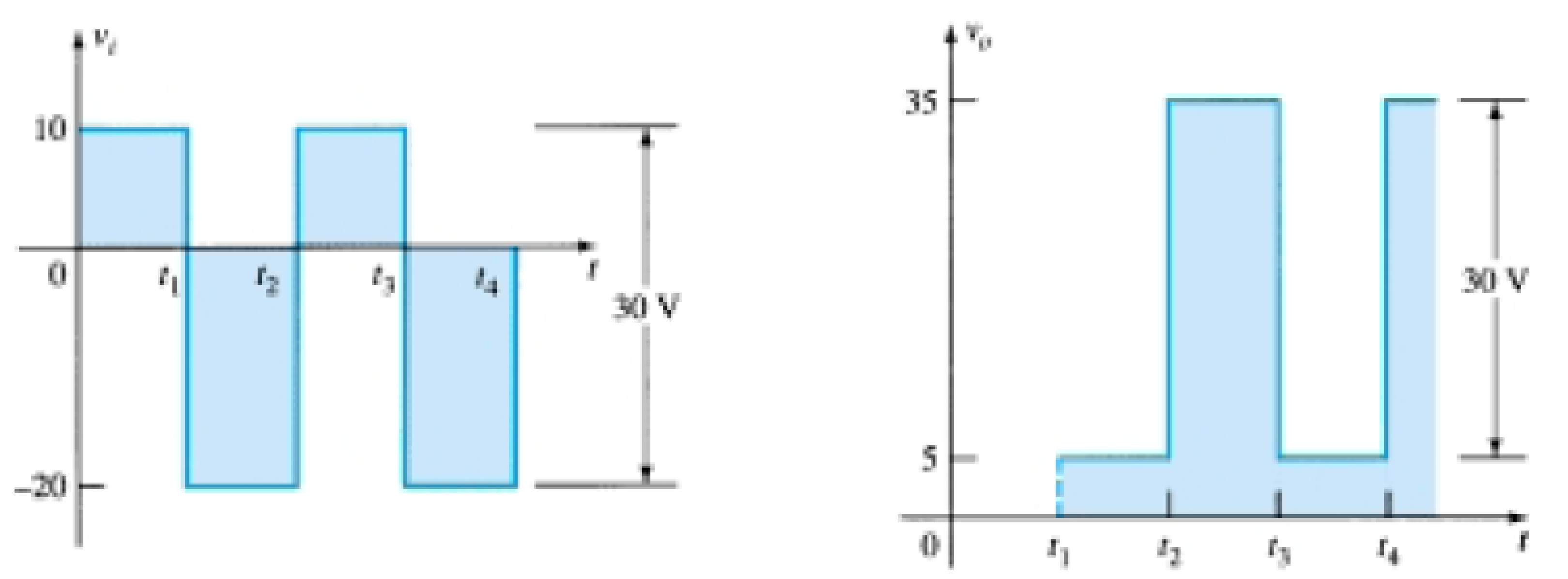
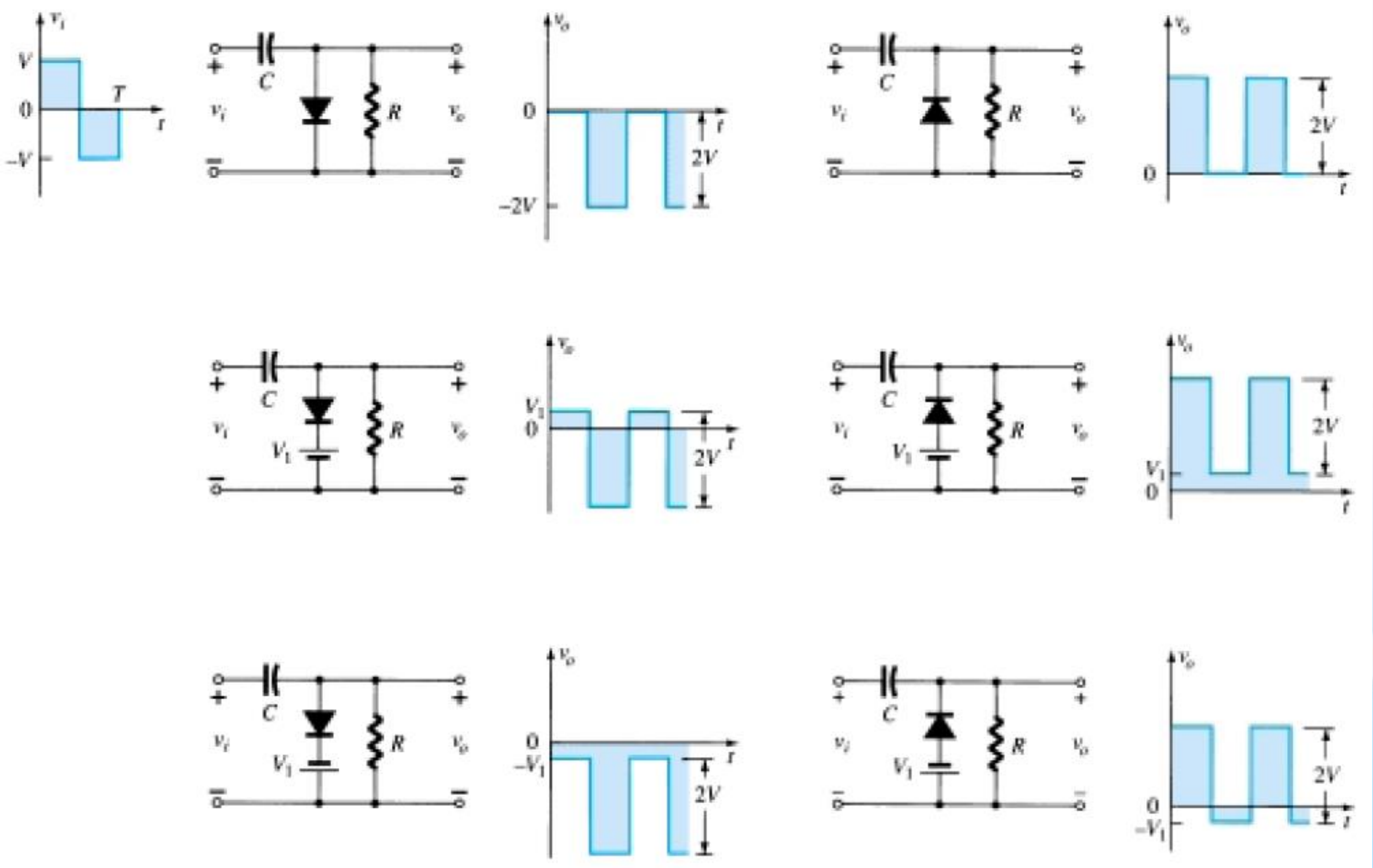


$$\tau = RC = (100\ \text{k}\Omega)(0.1\ \mu\text{F}) = 0.01\ \text{s} = 10\ \text{ms}$$

$$5\tau = 5(10\ \text{ms}) = 50\ \text{ms}.$$

CLAMPERS



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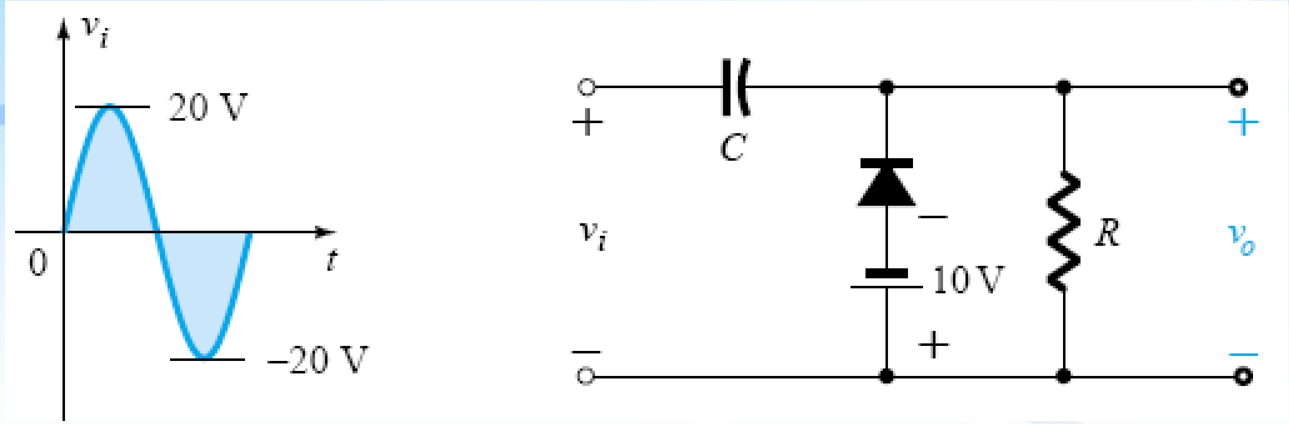
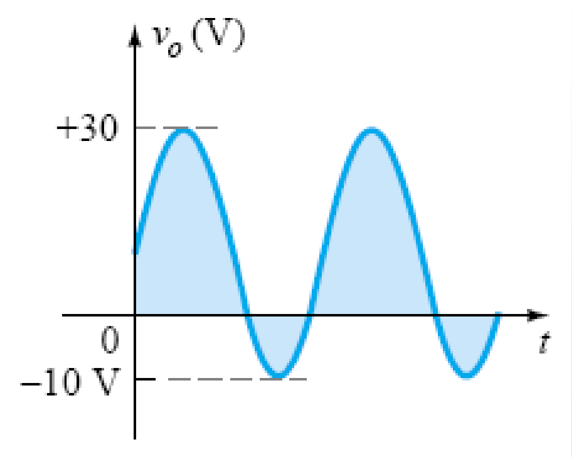
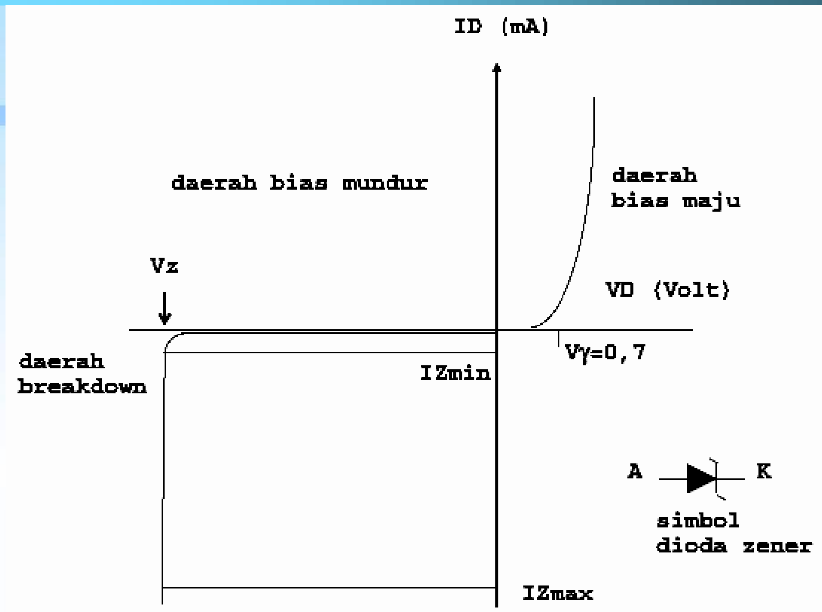
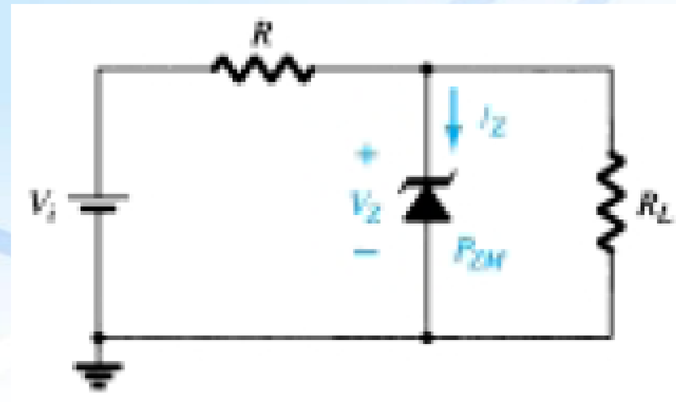




DIODA ZENER





- RL harus lebih besar dari RL minimum ➔ RL minimum, maka IL menjadi maksimum, sehingga Iz menjadi minimum.
- Vi harus lebih besar dari Vi minimum ➔ Vi minimum akan menjamin bahwa dioda mendapatkan tegangan *breakdown*.

Contoh

(a) For the Zener diode network of Fig. 2.109, determine V_L, V_R, I_Z, and P_Z.
(b) Repeat part (a) with $R_L = 3\ \mathrm{k\Omega}$.

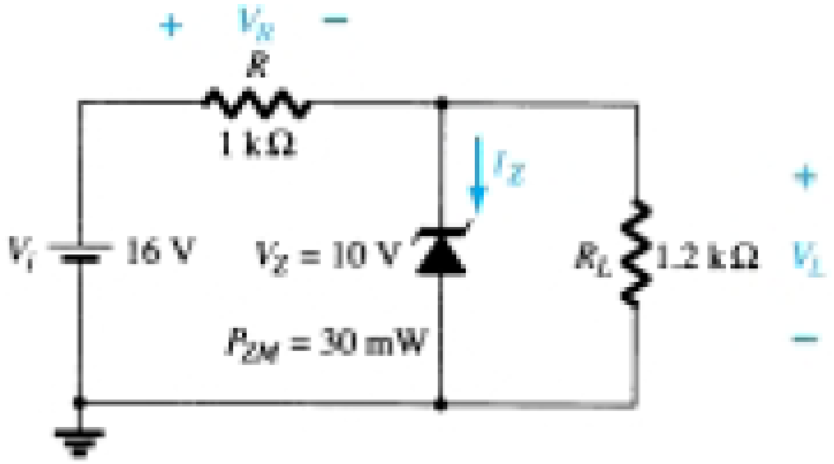


Figure 2.109 Zener diode regulator for Example 2.26.

Solution

(a) Following the suggested procedure the network is redrawn as shown in Fig. 2.110. Applying Eq. (2.16) gives

$$V = \frac{R_L V_i}{R + R_L} = \frac{1.2\ \mathrm{k\Omega}(16\ \mathrm{V})}{1\ \mathrm{k\Omega} + 1.2\ \mathrm{k\Omega}} = 8.73\ \mathrm{V}$$

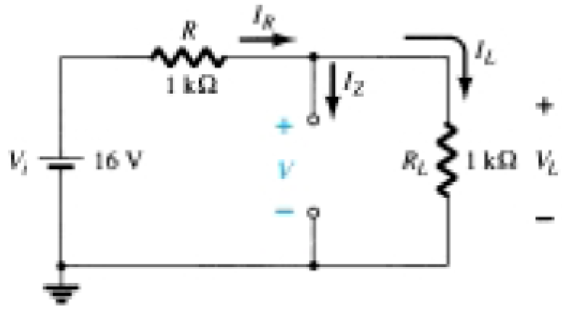


Figure 2.110 Determining V for the regulator of Fig. 2.109.

Since $V = 8.73$ V is less than $V_Z = 10$ V, the diode is in the "off" state as shown on the characteristics of Fig. 2.111. Substituting the open-circuit equivalent will result in the same network as in Fig. 2.110, where we find that

$$V_L = V = \mathbf{8.73\ V}$$

$$V_R = V_i - V_L = 16\ V - 8.73\ V = \mathbf{7.27\ V}$$

$$I_Z = \mathbf{0\ A}$$

and $$P_Z = V_Z I_Z = V_Z(0\ A) = \mathbf{0\ W}$$

(b) Applying Eq. (2.16) will now result in

$$V = \frac{R_L V_i}{R + R_L} = \frac{3\ k\Omega(16\ V)}{1\ k\Omega + 3\ k\Omega} = 12\ V$$

Since $V = 12$ V is greater than $V_Z = 10$ V, the diode is in the "on" state and the network of Fig. 2.112 will result. Applying Eq. (2.17) yields

$$V_L = V_Z = \mathbf{10\ V}$$

and $$V_R = V_i - V_L = 16\ V - 10\ V = \mathbf{6\ V}$$

with $$I_L = \frac{V_L}{R_L} = \frac{10\ V}{3\ k\Omega} = 3.33\ mA$$

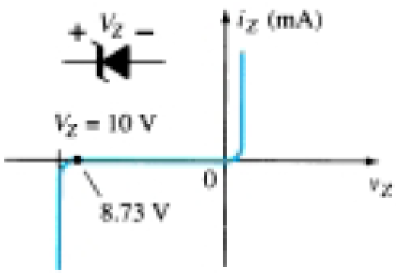


Figure 2.111 Resulting operating point for the network of Fig. 2.109.

and $$I_R = \frac{V_R}{R} = \frac{6\text{ V}}{1\text{ k}\Omega} = 6\text{ mA}$$

so that $$I_Z = I_R - I_L \text{ [Eq. (2.18)]}$$

$$= 6\text{ mA} - 3.33\text{ mA}$$

$$= \mathbf{2.67\ mA}$$

The power dissipated,

$$P_Z = V_Z I_Z = (10\text{ V})(2.67\text{ mA}) = \mathbf{26.7\ mW}$$

which is less than the specified $P_{ZM} = 30$ mW.

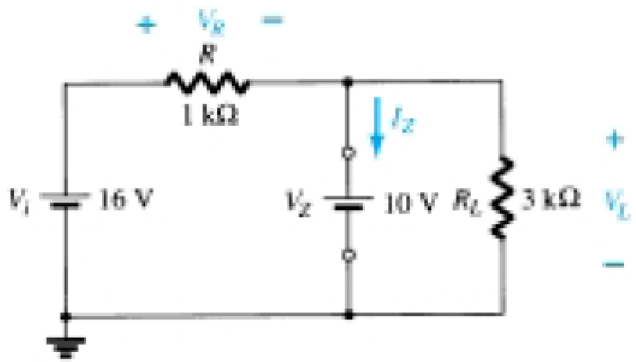


Figure 2.112 Network of Fig. 2.109 in the "on" state.

CONTOH

Determine the current I for the network of Fig. 2.32.

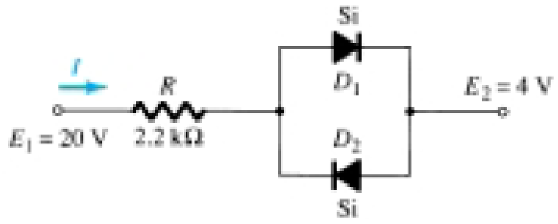


Figure 2.32 Network for Example 2.13.

Solution

Redrawing the network as shown in Fig. 2.33 reveals that the resulting current direction is such as to turn on diode D_1 and turn off diode D_2. The resulting current I is then

$$I = \frac{E_1 - E_2 - V_D}{R} = \frac{20\text{ V} - 4\text{ V} - 0.7\text{ V}}{2.2\text{ k}\Omega} \cong \mathbf{6.95\ mA}$$

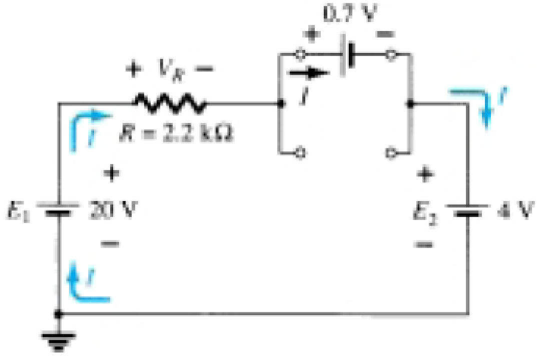


Figure 2.33 Determining the unknown quantities for the network of Example 2.13.

CONTOH

Determine V_o, I_1, I_{D_1}, and I_{D_2} for the parallel diode configuration of Fig. 2.30.

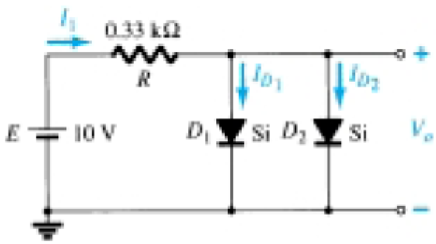


Figure 2.30 Network for Example 2.12.

Solution

For the applied voltage the "pressure" of the source is to establish a current through each diode in the same direction as shown in Fig. 2.31. Since the resulting current direction matches that of the arrow in each diode symbol and the applied voltage is greater than 0.7 V, both diodes are in the "on" state. The voltage across parallel elements is always the same and

$$V_o = \mathbf{0.7\ V}$$

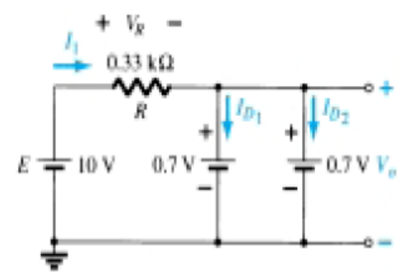


Figure 2.31 Determining the unknown quantities for the network of Example 2.12.

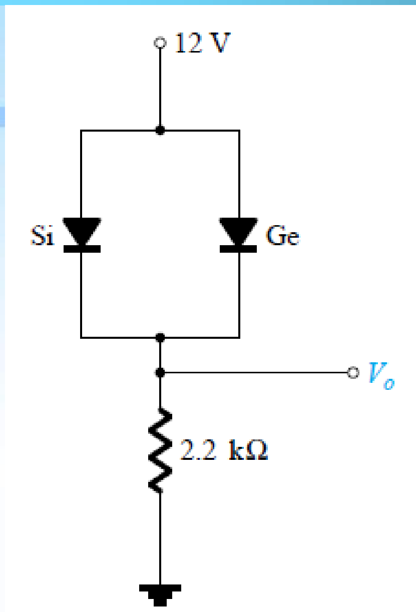
The current

$$I_1 = \frac{V_R}{R} = \frac{E - V_D}{R} = \frac{10\ \text{V} - 0.7\ \text{V}}{0.33\ \text{k}\Omega} = \mathbf{28.18\ mA}$$

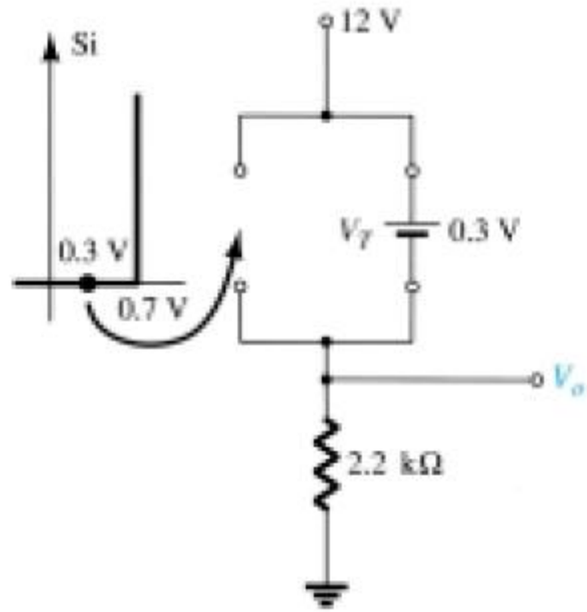
Assuming diodes of similar characteristics, we have

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

CONTOH



$$V_o = 12\text{ V} - 0.3\text{ V} = \mathbf{11.7\ V}$$



CONTOH