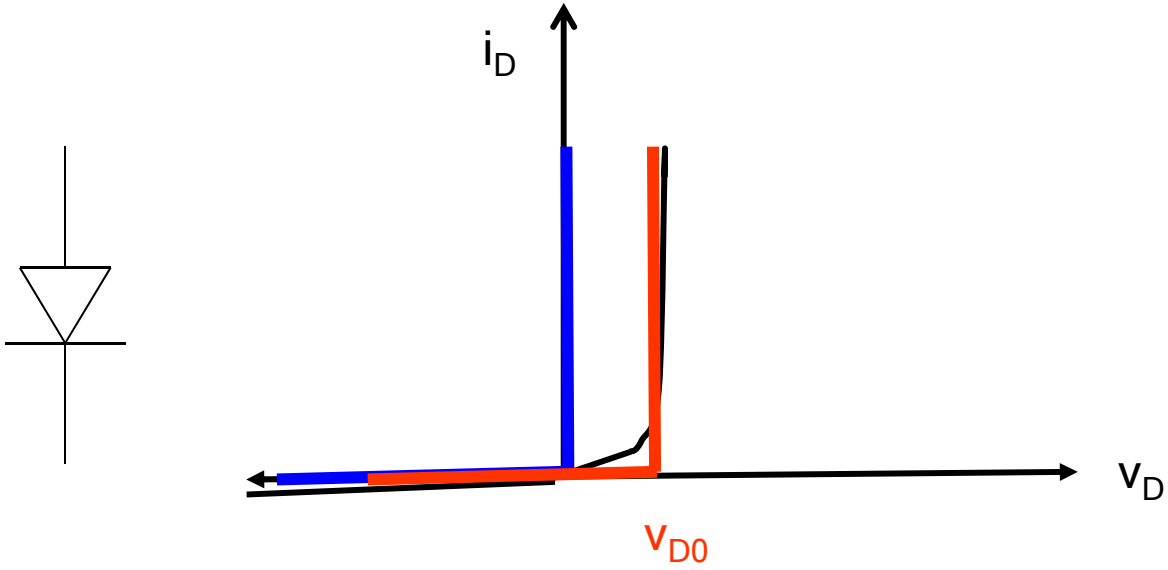
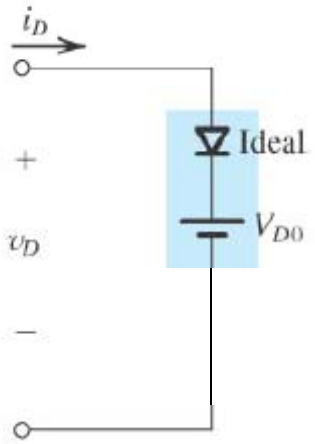
Lect. 7: Diode Circuits

Ideal diode model

PN Junction Diode



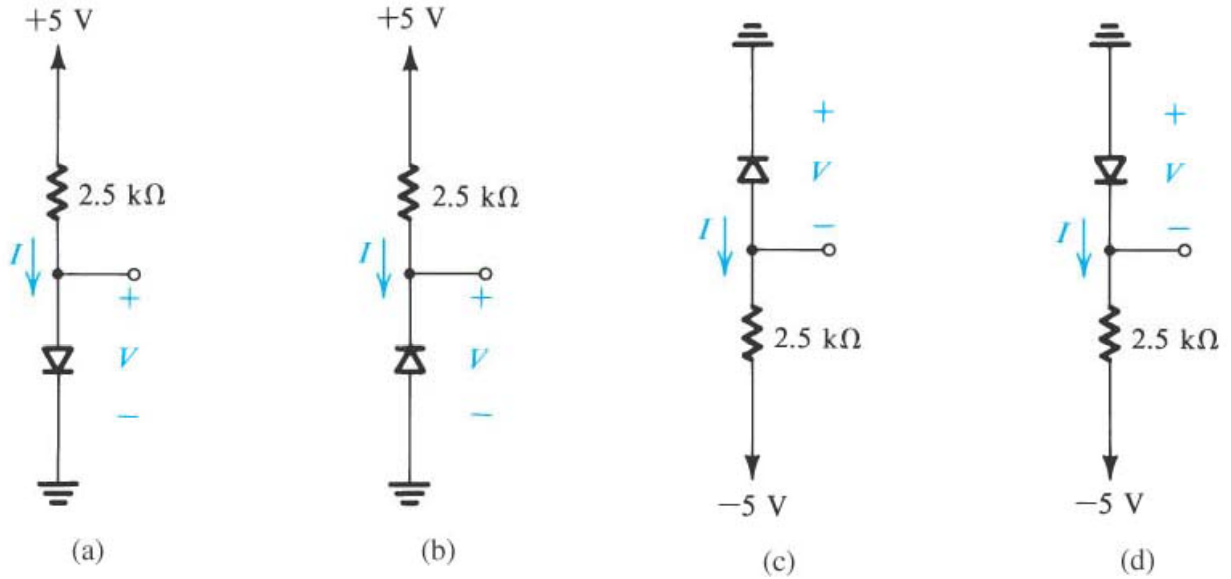


More Accurate Linear Approximation
➔ Constant-voltage drop model

Typically,
v_{D0}: 0.6 - 0.7V

Lect. 7: Diode Circuits

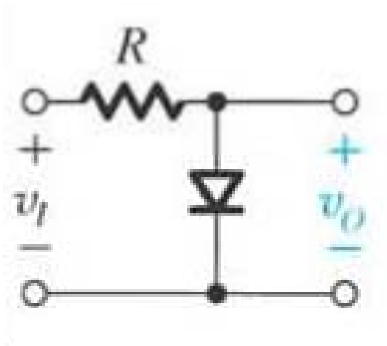
Solve the following diode circuits using the constant voltage drop model with v_{DO} = 0.7 V.



I=1.72mA, V=0.7V I=0, V=5V I=0, V=5V I=1.72mA, V=0.7V

Lect. 7: Diode Circuits

Plot v_O vs v_I . Use constant voltage drop (0.7 V) model.

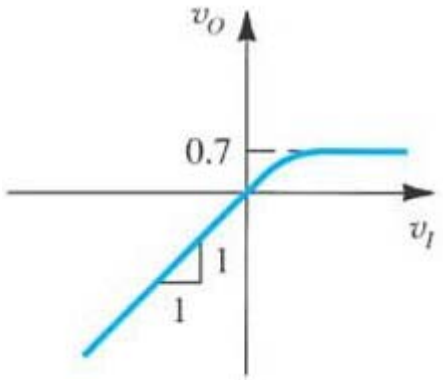


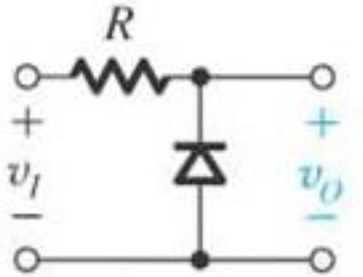
Diode On:

$v_O = 0.7,\ v_I > 0.7$

Diode Off:

$v_O = v_I,\ v_I < 0.7$



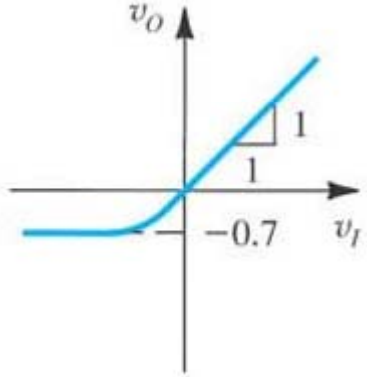


Diode On:

$v_O = -0.7,\ v_I < -0.7$

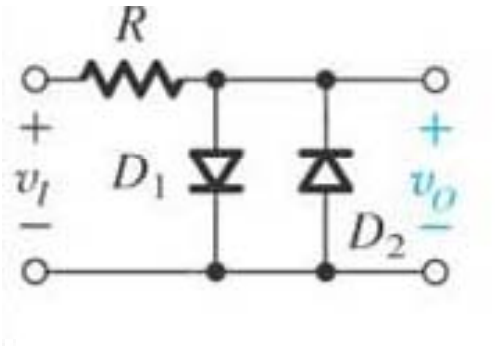
Diode Off:

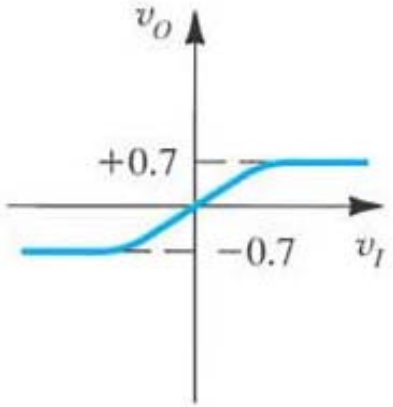
$v_O = v_I,\ v_I > -0.7$



What is the function? **Limiters**

Lect. 7: Diode Circuits





D1 On, D2 Off: $v_O = 0.7$, $v_I > 0.7$

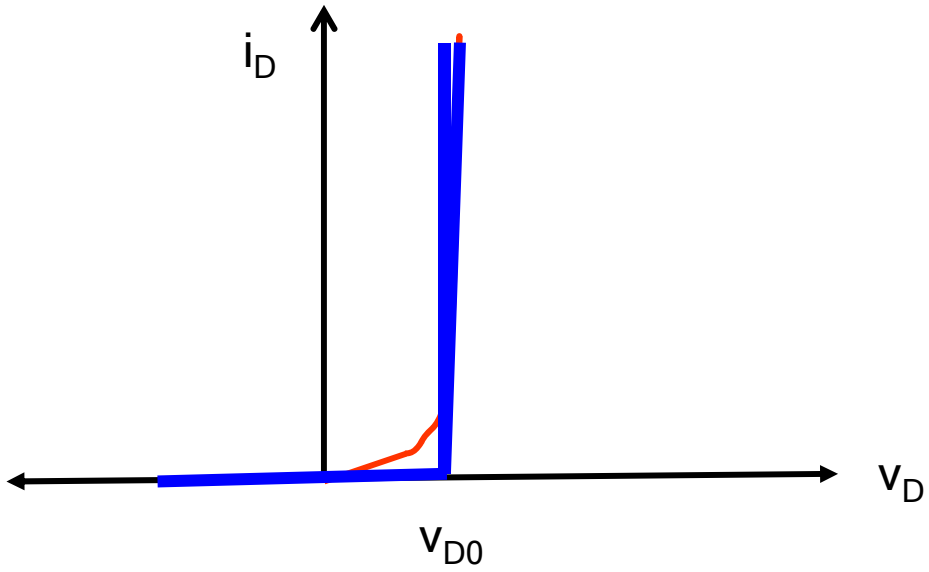
D1 Off, D2 On: $v_O = -0.7$, $v_I < -0.7$

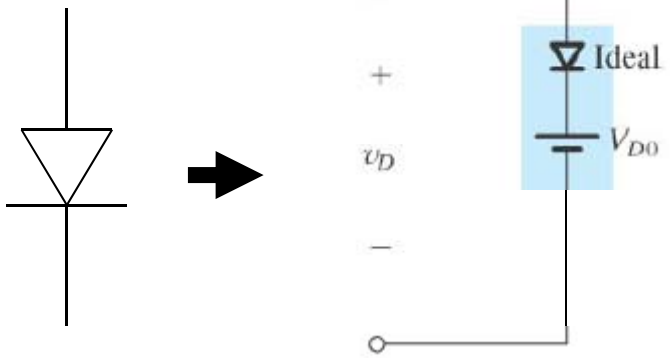
D1 Off, D2 Off: $v_O = v_I$, $-0.7 < v_I < 0.7$

D1 On, D2 On ?

Lect. 7: Diode Circuits

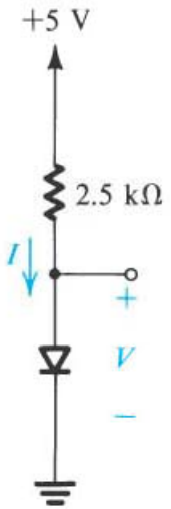
A little more accurate model ➔ Piece-wise linear model





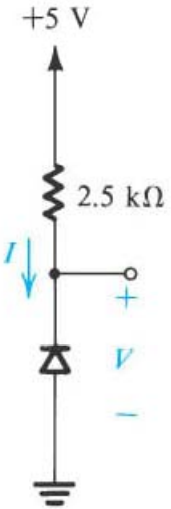
Lect. 7: Diode Circuits

Solve the following diode circuits using contstant voltage drop model with v_{DO} = 0.7 V and r_D = 20 ohm.



(a)

I=1.71mA, V=0.73V

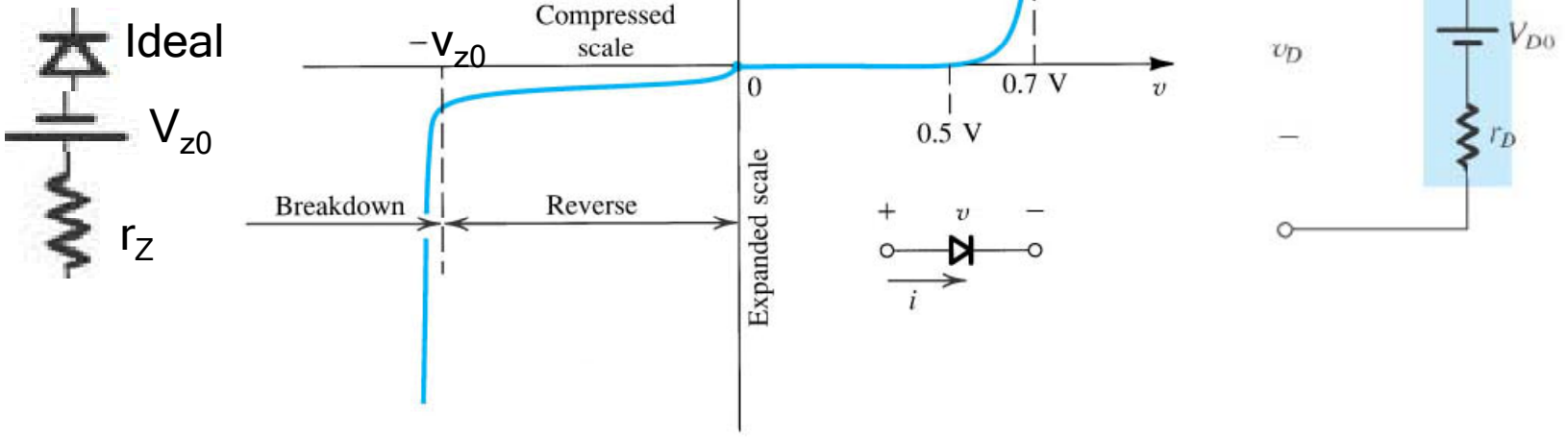


(b)

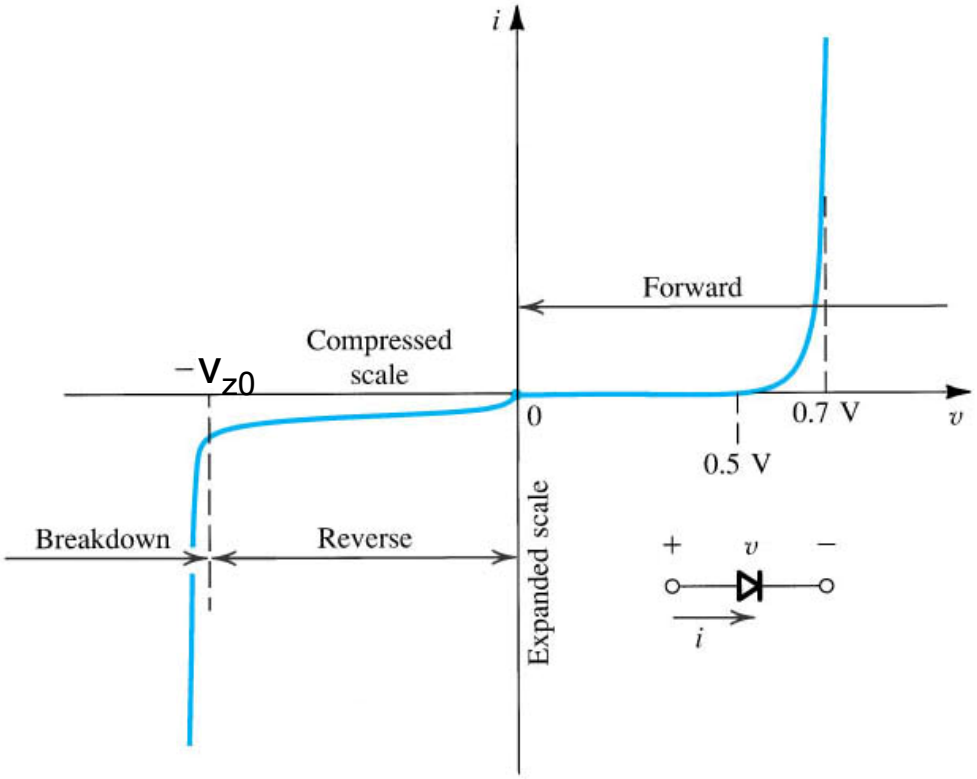
I=0, V=5V

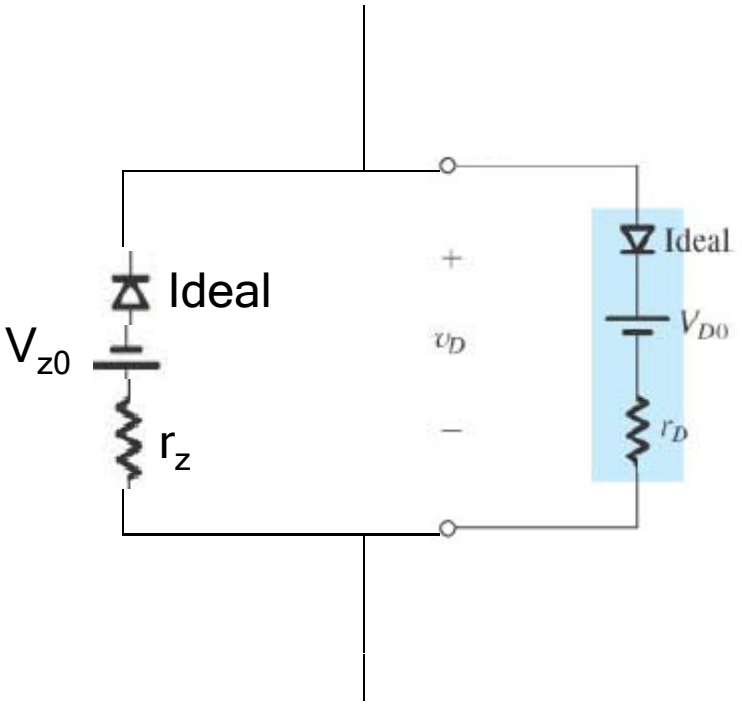
Lect. 7: Diode Circuits

How about the breakdown?



Lect. 7: Diode Circuits

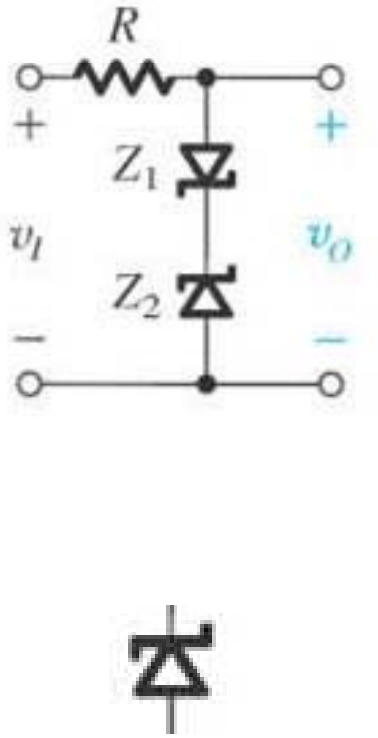




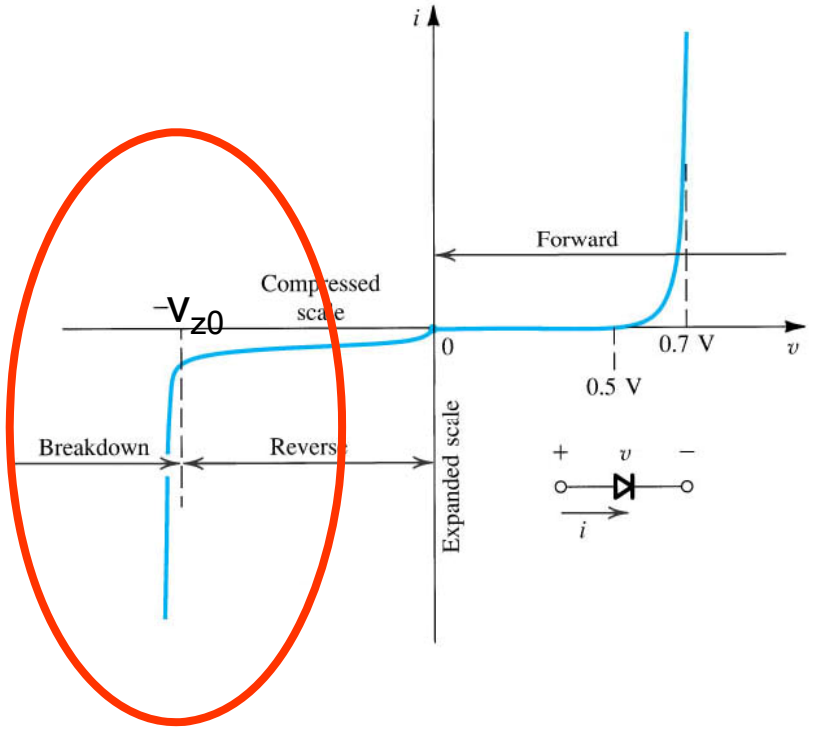
- Diode is Forward ON
- Diode is Reverse ON
- Diode is OFF

➔ Piece-wise linear model

Lect. 7: Diode Circuits



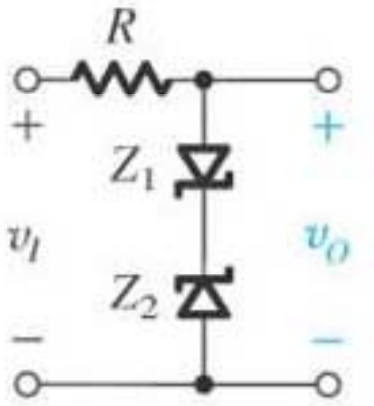
Zener diode



Use the reverse breakdown region

➔ Design the diode for desired V_{ZO}

Lect. 7: Diode Circuits

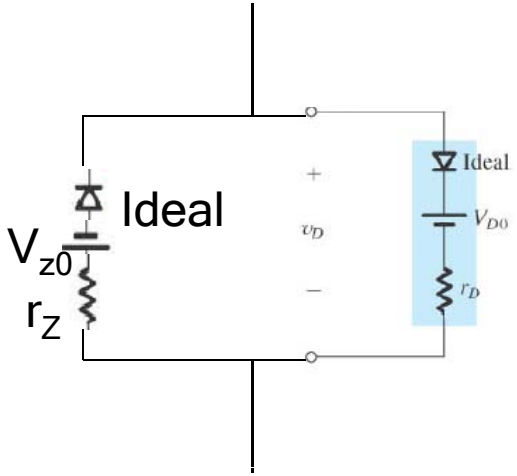


With $r_D = 0$

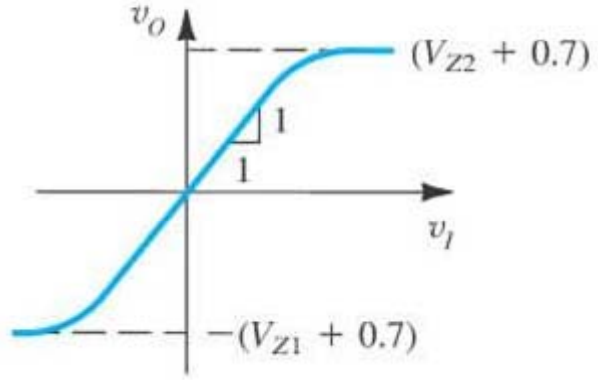
Current conduction possible if

Z_1 is Forward ON and Z_2 is Reverse ON
➔ $v_O = 0.7 + V_{Z0}$, $v_I > 0.7 + V_{Z0}$

Z_2 is Forward ON and Z_1 is Reverse ON
➔ $v_O = -0.7 - V_{Z0}$, $v_I > -0.7 - V_{Z0}$



Z_1 and Z_2 both OFF
➔ $v_O = v_I$
$-0.7 - V_Z < v_O < 0.7 + V_Z$



With non-zero r_D?

Lect. 7: Diode Circuits

Homework: Plot V_{out} vs. V_{in} for the following circuit. Use Von = 0.7V.
What is the function of this circuit?
(Hint: Read "Full-Wave Rectifier" , p. 96 – 99 in Razavi)