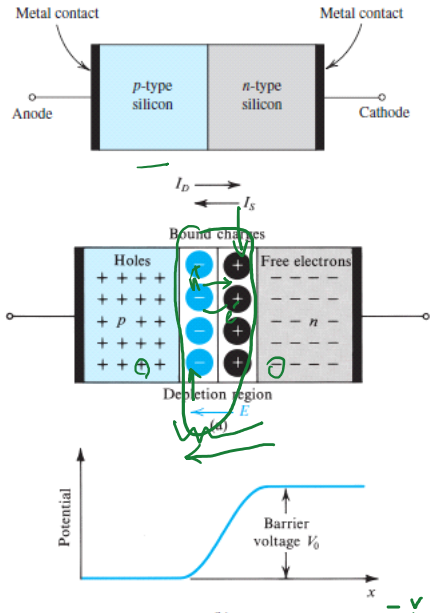
Reading

Adel S. Sedra and Kenneth C. Smith, **Microelectronic Circuits** 7th Edition, *Oxford University Press*, 2014.

- Chapter 4.1, 4.3, 4.4

Review



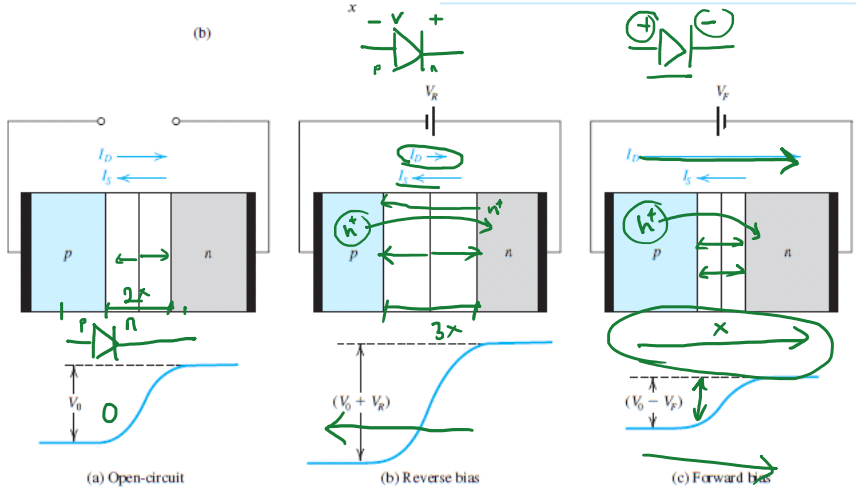
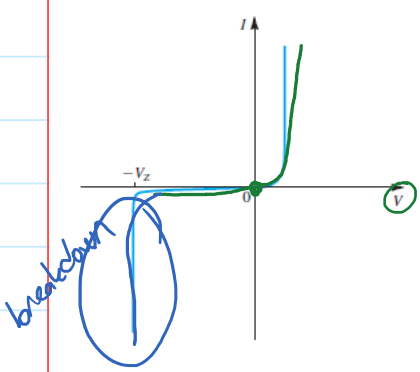


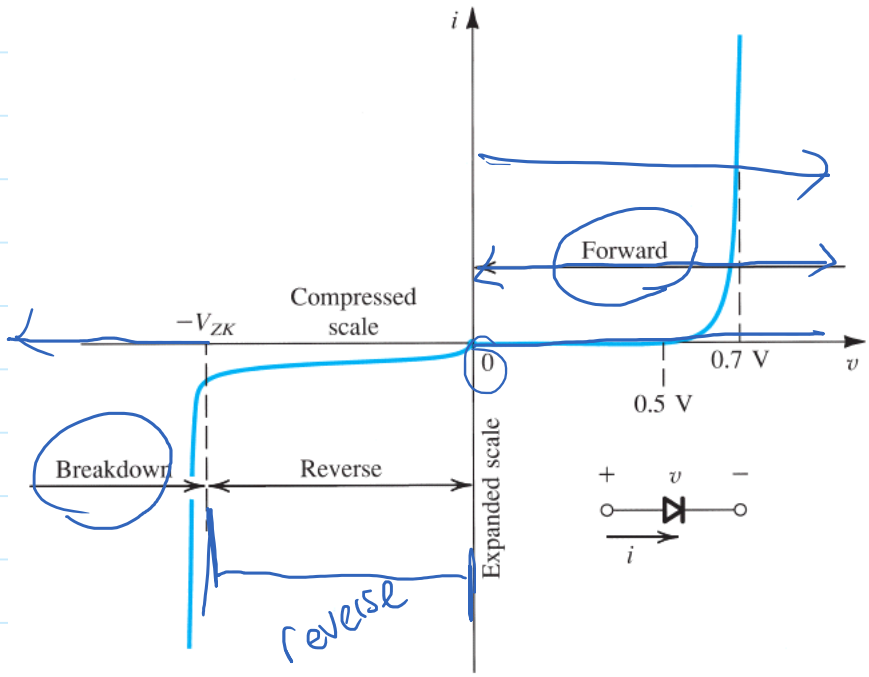
Figure 3.11 The *pn* junction in: (a) equilibrium; (b) reverse bias; (c) forward bias.

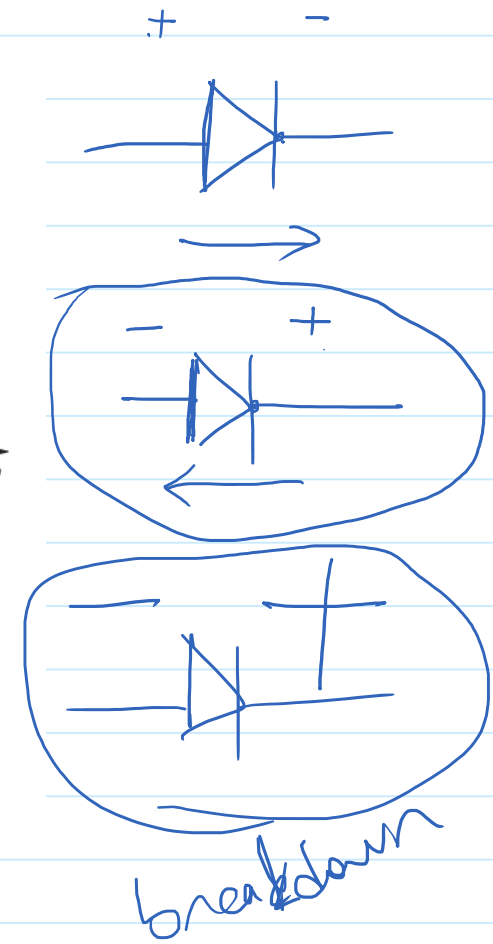


$$I = I_s(e^{V/V_T} - 1)$$

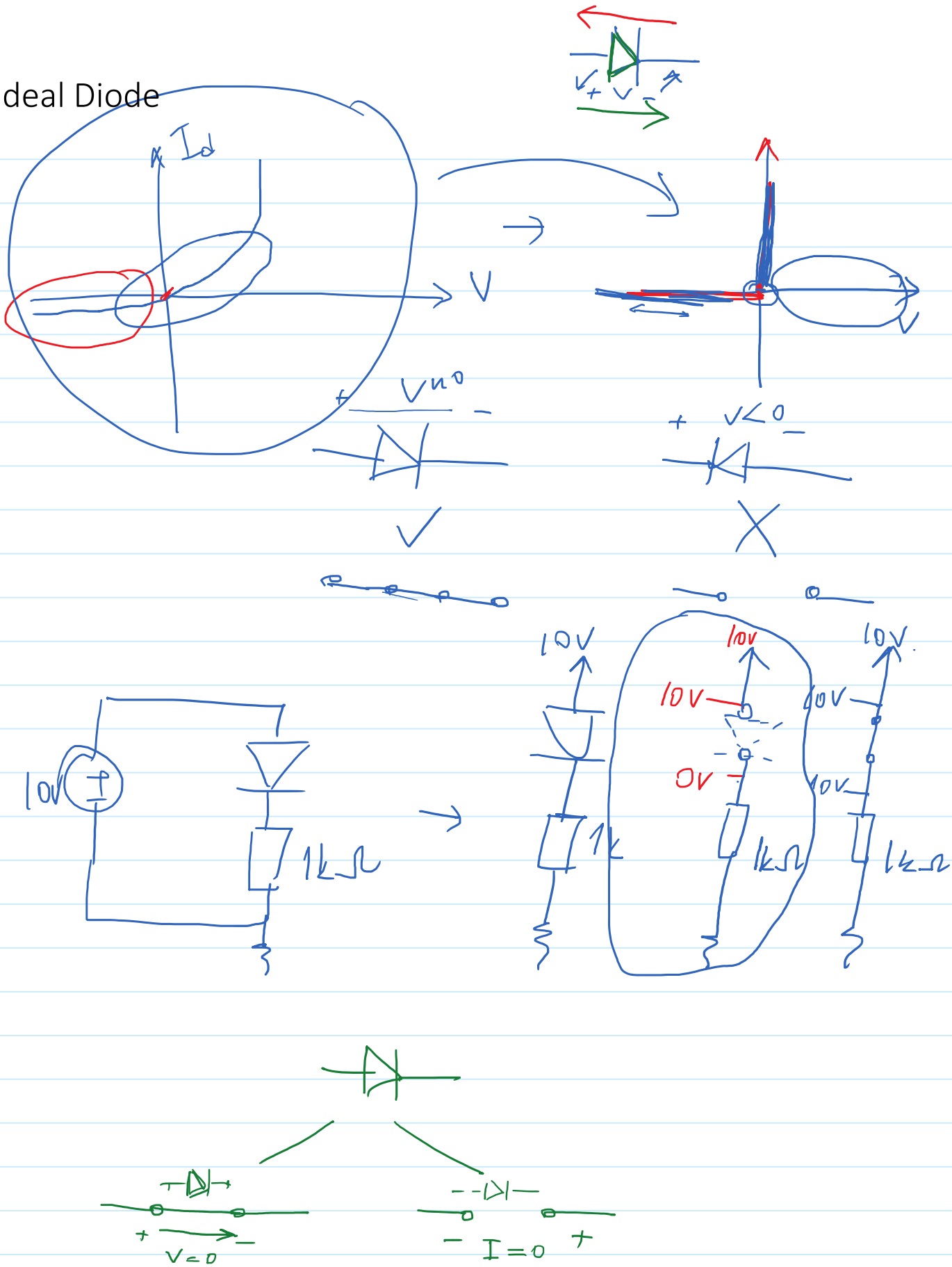
$$I_s = Aqn_i^2\left(\frac{D_p}{L_pN_D} + \frac{D_n}{L_nN_A}\right)$$

Operating Regions of Diodes

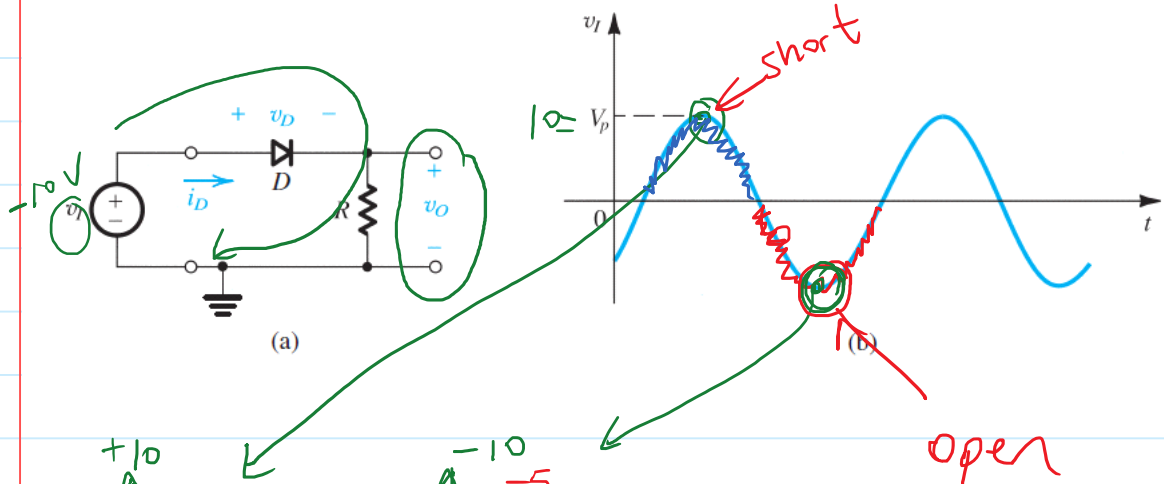


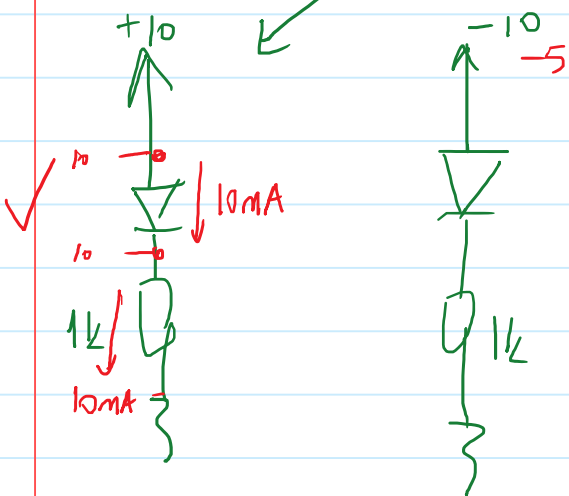


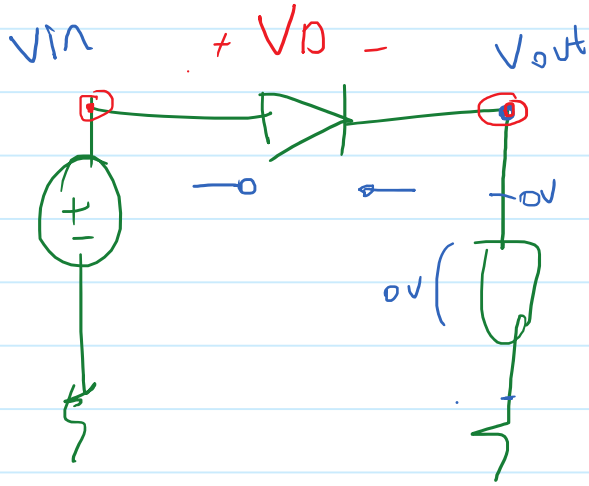
Ideal Diode

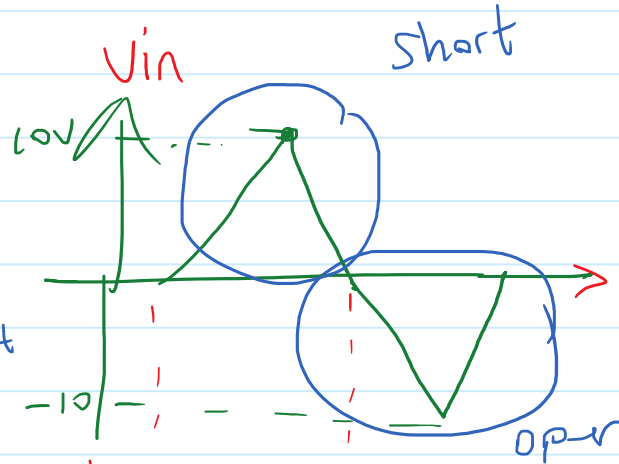


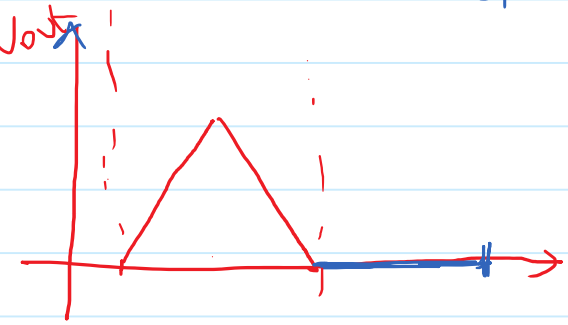
Example



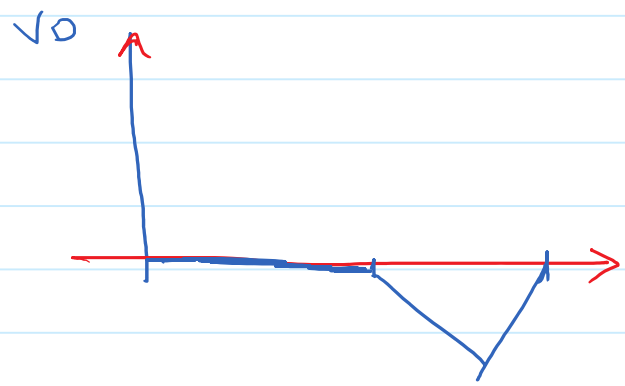








$$V_D = V_{in} - V_{out}$$
$$0$$



Example

Figure 4.4(a) shows a circuit for charging a 12-V battery. If v_s is a sinusoid with 24-V peak amplitude, find the fraction of each cycle during which the diode conducts. Also, find the peak value of the diode current and the maximum reverse-bias voltage that appears across the diode.

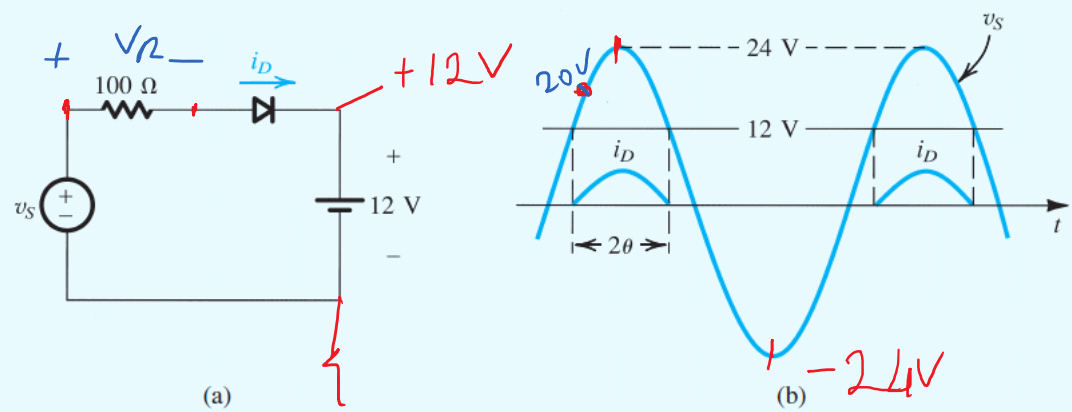
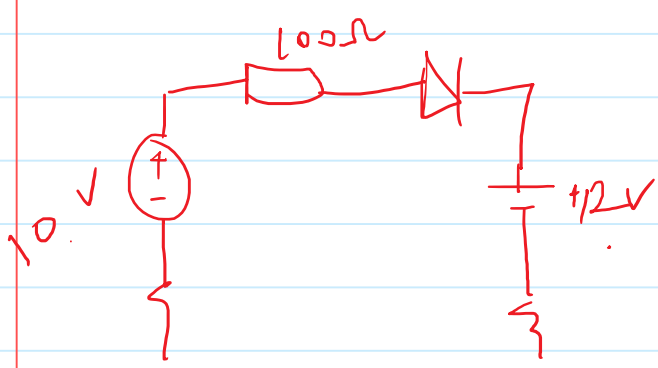
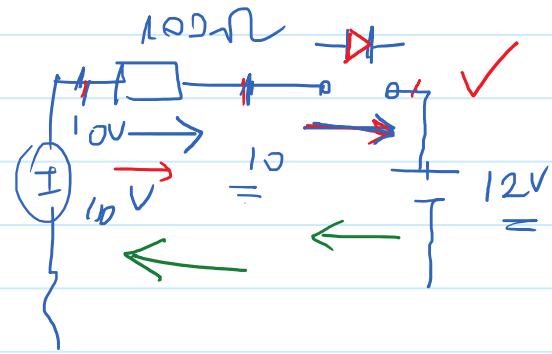


Figure 4.4 Circuit and waveforms for Example 4.1.



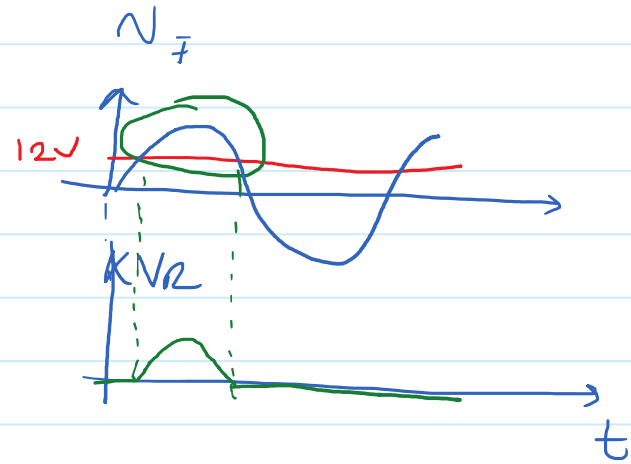


$v_s = 24V \rightarrow V_R = 12V$

$v_s = 20V \rightarrow V_R = 8V$

$v_s = 12V \rightarrow V_R = 0V$

$v_s = 10V \rightarrow V_R = 0$



Example

Assuming the diodes to be ideal, find the values of I and V in the circuits of Fig. 4.6.

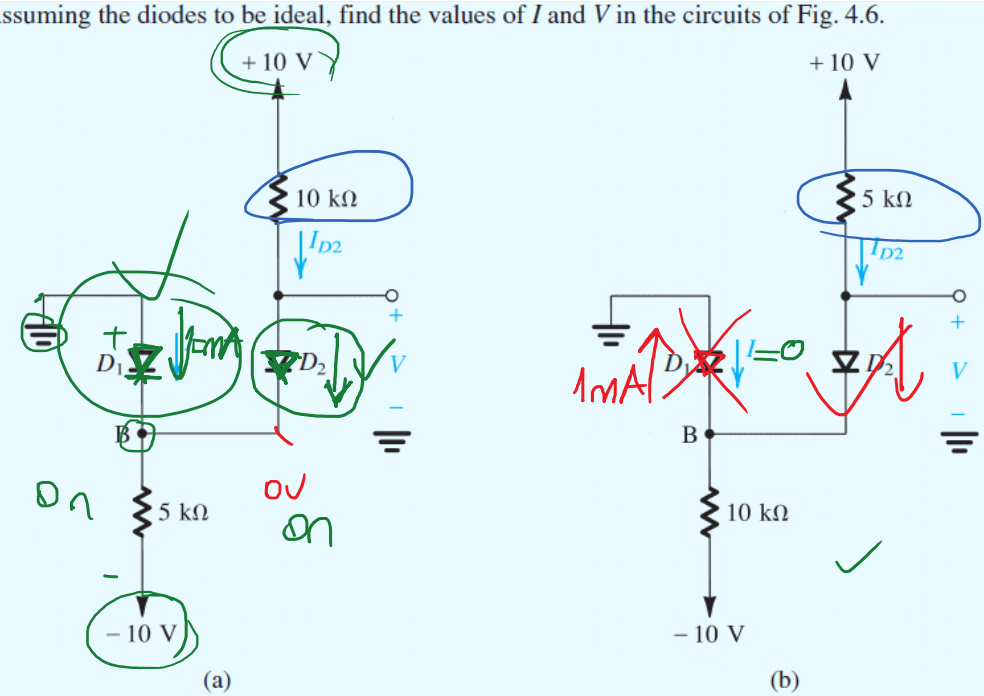
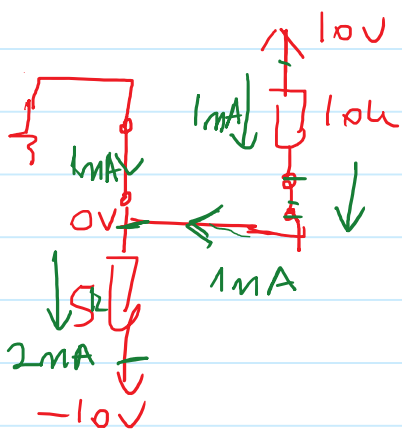
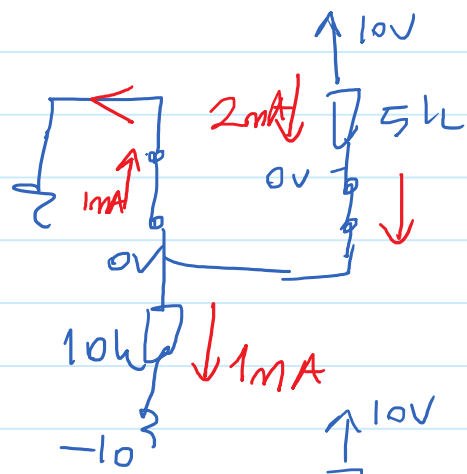
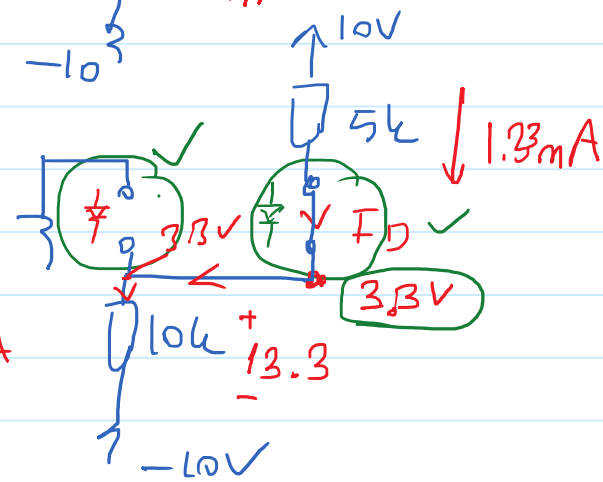


Figure 4.6 Circuits for Example 4.2.





D1 D2
on on
off on

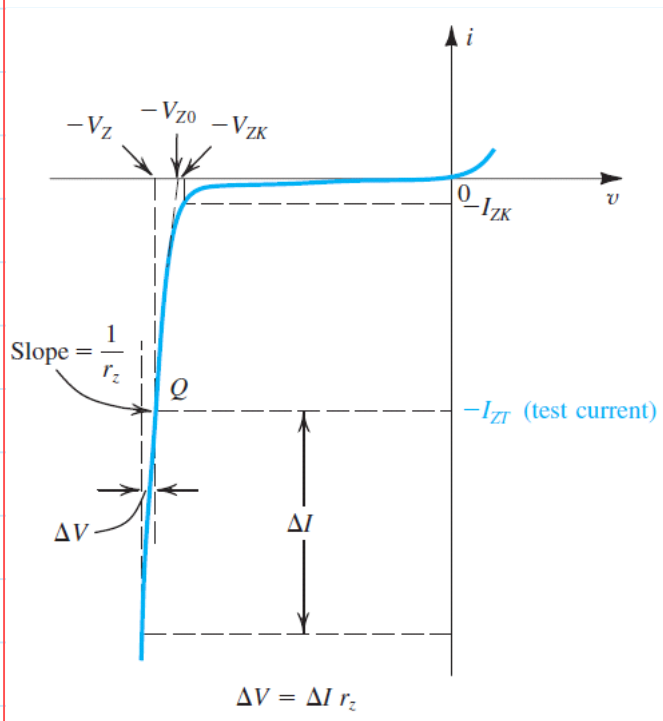


$$I_D = \frac{10+10}{15k} \approx 1.3mA$$

Exponential Model

Constant Voltage Drop Model

Reverse Breakdown - Zener Diodes



Example

Template