Fill in the blanks in the following circuits. For some of the simple calculations, you may simply write down the answer without showing work.

Assume the diodes are silicon with a 0.7V forward voltage drop:

1. \( R = 330 \Omega \) \( V_R = \) _________
   \[ \begin{array}{c}
   \text{4-V} \\
   \downarrow \\
   \text{+} \\
   \text{V_D} = \text{_________} \\
   \uparrow \\
   \text{4-V} \\
   \end{array} \]
   \( I_D = \) _________

Assume the LEDs have a 2V forward voltage drop:

2. \( R = 330 \Omega \) \( V_R = \) _________
   \[ \begin{array}{c}
   \text{4-V} \\
   \downarrow \\
   \text{+} \\
   \text{V_D} = \text{_________} \\
   \uparrow \\
   \text{4-V} \\
   \end{array} \]
   \( I_D = \) _________

3. \( V_D = \) _________ \( V_R = \) _________
   \[ \begin{array}{c}
   12-V \\
   \downarrow \\
   \text{+} \\
   \text{D} \\
   \text{R} = 510 \Omega \\
   \text{4-V} \\
   \end{array} \]
   \( I = \) _________

4. \( V_D1 = \) _________ \( V_R = \) _________
   \[ \begin{array}{c}
   12-V \\
   \downarrow \\
   \text{+} \\
   \text{D} \\
   \text{R} = 510 \Omega \\
   \text{4-V} \\
   \end{array} \]
   \( I = \) _________ \( V_D2 = \) _________

Note: In problems 5 and 6 you'll have to make some assumptions about which diode(s) is/are conducting. Work the problem with those assumptions and see if you arrive at impossible answers. If so, change your assumptions and try again.

5. \( V_{D1} = \) _________ \( V_{D2} = \) _________
   \[ \begin{array}{c}
   10-V \\
   \downarrow \\
   \text{+} \\
   \text{D} \\
   \text{R} = 220 \Omega \\
   \text{8-V} \\
   \end{array} \]
   \( I_1 = \) _________ \( I_2 = \) _________

There are four possible assumptions.
1. Neither diode conducts.
2. Only \( D_1 \) conducts.
3. Only \( D_2 \) conducts.
4. Both diodes conduct.

NOTE: You don't have to try all four possibilities. As soon as you find one that works, that's the answer. So make your best guess first.
6. \( I_T = \) _________ \( V_{D1} = \) _________

\[
\begin{aligned}
&I_{D1} \quad + \quad V_{D1} \quad - \\
&12 \cdot V \\
&I_{R2} \quad + \quad V_{D1} \\
&I_{D2} = \quad + \\
&I_{R1} \quad - \quad V_{D2} \\
&I_{R3} = \quad + \\
&I_{R1} \quad - \quad R_1 := 150 \cdot \Omega \\
&R_2 := 820 \cdot \Omega \\
&I_{R2} = \quad - \\
&R_3 := 1 \cdot k\Omega
\end{aligned}
\]

7. \( I_T = \) _________ \( V_{D1} = \) _________

\[
\begin{aligned}
&I_{D1} \quad + \quad V_{D1} \quad - \\
&12 \cdot V \\
&I_{R2} \quad + \quad V_{D1} \\
&I_{D2} = \quad + \\
&I_{R1} \quad - \quad V_{D2} \\
&I_{R3} = \quad + \\
&I_{R1} \quad - \quad R_1 := 150 \cdot \Omega \\
&R_2 := 820 \cdot \Omega \\
&I_{R2} = \quad - \\
&R_3 := 1 \cdot k\Omega
\end{aligned}
\]

8. \( V_R = \) _________

\[
\begin{aligned}
&6 \cdot V \\
&I_D := 15 \cdot mA \\
&\text{LED}
\end{aligned}
\]

9. \( R = \) _________

\[
\begin{aligned}
&14 \cdot V \\
&I_D := 20 \cdot mA
\end{aligned}
\]

10. \( I_{R1} := 30 \cdot mA \)

\[
\begin{aligned}
&R_1 = \quad - \\
&R_2 := 300 \cdot \Omega \\
&R_3 = \quad - \\
&12 \cdot V
\end{aligned}
\]

\[
\begin{aligned}
&I_{D2} := 20 \cdot mA
\end{aligned}
\]
11. \( V_R = \) \_
\[ R = \]
\[ P_R = \] (power)

\[ 18 \cdot V \]

\[ V_Z : = 12 \cdot V \]

\[ I_D : = 50 \cdot mA \]

\[ P_D = \]

12. \( I_R = \)

\[ R : = 120 \cdot \Omega \]

\[ P_R = \]

\[ 18 \cdot V \]

\[ V_Z : = 12 \cdot V \]

\[ I_D = \]

\[ R_L : = 300 \cdot \Omega \]

\[ P_D = \]

13. \( I_R = \)

\[ R : = 120 \cdot \Omega \]

\[ P_R = \]

\[ 18 \cdot V \]

\[ V_Z : = 12 \cdot V \]

\[ I_D = \]

\[ R_L : = 200 \cdot \Omega \]

\[ P_D = \]

Warning: If \( I_D \) turns out negative, it is actually 0 and you must recalculate everything else.

You will need more paper for the next two problems, add a sheet or two.

14. Assume that diode \( D_1 \) does conduct. Assume that diode \( D_2 \) does NOT conduct.

a) Find \( V_{R1}, I_{R1}, I_{R3}, I_{D1}, V_{R2} \) based on these assumptions.

Stick with these assumptions even if your answers come out absurd.

\( V_{R1} = ? \) \quad \( I_{R1} = ? \) \quad \( I_{R3} = ? \) \quad \( I_{D1} = ? \)

\( V_{R2} = ? \)

\( V_{\text{in}} : = 4 \cdot V \)

\[ R_1 : = 50 \cdot \Omega \]

\[ R_2 : = 150 \cdot \Omega \]

\[ R_3 : = 400 \cdot \Omega \]
b) Was the assumption about \( D_1 \) correct? yes or no  
How do you know? (Specifically show a value which is or is not within a correct range.)

c) Was the assumption about \( D_2 \) correct? yes or no  
How do you know?

15. In the circuit shown, use the constant-voltage-drop model for the silicon diode.  
a) Assume that diode \( D_1 \) does NOT conduct.  
Assume that diode \( D_2 \) does conduct.  
Find \( V_{R2} \), \( I_{R1} \), \( I_{D2} \), based on these assumptions.  
Stick with these assumptions even if your answers come out absurd. Hint: think in nodal voltages.  
\[ V_{R2} = ? \quad V_{R1} = ? \quad I_{R1} = ? \quad I_{D2} = ? \]

b) Based on your numbers above, does it look like the assumption about \( D_1 \) was correct? yes or no  
How do you know? (Specifically show a value which is or is not within a correct range.)

c) Based on your numbers above, does it look like the assumption about \( D_2 \) was correct? yes or no  
How do you know?

**Answers**

1. \( V_D = 0.7 \text{ V} \quad V_R = 3.3 \text{ V} \quad I_D = 10 \text{ mA} \quad V_D = -0.4 \text{ V} \quad V_R = 0 \text{ V} \)
2. \( I_D = 0 \text{ mA} \quad V_D = 2.5 \text{ V} \quad V_D = 0 \text{ V} \quad V_R = 0 \text{ V} \)
3. \( I_D = 0 \text{ mA} \quad V_D = -8 \text{ V} \quad V_D = 0 \text{ V} \)
4. \( I_D = 0 \text{ mA} \quad V_D = 2.5 \text{ V} \quad I_D = 0 \text{ mA} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \)
5. \( I_D = 0 \text{ mA} \quad V_D = 2.5 \text{ V} \quad V_D = -1.3 \text{ V} \quad I_R = 42 \text{ mA} \quad V_D = -0.7 \text{ V} \quad V_D = -1.3 \text{ V} \quad V_R = 0 \text{ V} \)
6. \( I_D = 0 \text{ mA} \quad V_D = -1.3 \text{ V} \quad V_D = -0.7 \text{ V} \quad I_R = 13.8 \text{ mA} \quad V_D = -1.3 \text{ V} \quad V_D = -0.7 \text{ V} \quad V_R = 0 \text{ V} \)
7. \( I_D = 0 \text{ mA} \quad V_D = 14.3 \text{ mA} \quad V_D = 0 \text{ mA} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \)
8. \( V_R = 0.7 \text{ V} \quad V_R = 7.3 \text{ V} \quad I_R = 10 \text{ mA} \quad V_R = 2.5 \text{ V} \quad V_R = 0 \text{ V} \)
9. \( R = 267 \Omega \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \)
10. \( R_1 = 233 \Omega \quad R_3 = 150 \Omega \quad R_3 = 150 \Omega \quad R_3 = 150 \Omega \quad R_3 = 150 \Omega \)
11. \( V_R = 0.7 \text{ V} \quad V_R = 6.3 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \)
12. \( V_R = 50 \text{ mA} \quad I_R = 50 \text{ mA} \quad I_D = 10 \text{ mA} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \)
13. \( V_R = 50 \text{ mA} \quad I_R = 50 \text{ mA} \quad I_D = 10 \text{ mA} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \)
14. \( V_R = 0.7 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \)
15. \( V_R = 1.2 \text{ V} \quad V_R = 1.2 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \quad V_R = 0 \text{ V} \)

b) Based on your numbers above, does it look like the assumption about \( D_1 \) was correct? yes or no  
How do you know? (Specifically show a value which is or is not within a correct range.)

c) Based on your numbers above, does it look like the assumption about \( D_2 \) was correct? yes or no  
How do you know?