Name: $\qquad$
Fill in the blanks in the following circuits. For some of the simple calculations, you may simply write down the answer without showing work.
1.


Assume the diodes are silicon with a 0.7 V forward voltage drop:
Assume the LEDs have a 2 V forward voltage drop:
2. $\mathrm{R}:=330 \cdot \Omega \quad \mathrm{~V}_{\mathrm{R}}=$ $\qquad$

$I_{D}=$ $\qquad$
3.

$\mathrm{I}=$ $\qquad$
4.

$\mathrm{I}=$ $\qquad$ $\mathrm{V}_{\mathrm{D} 2}=$ $\qquad$

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.


There are four possible assumptions.

1. Neither diode conducts.
2. Only $\mathrm{D}_{1}$ conducts.
3. Only $\mathrm{D}_{2}$ 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. $\mathrm{I}_{\mathrm{T}}=$ $\qquad$

7. $\mathrm{I}_{\mathrm{T}}=$

8. $\mathrm{V}_{\mathrm{R}}=$

9. $\mathrm{R}=$

10. $\mathrm{I}_{\mathrm{R} 1}:=30 \cdot \mathrm{~mA} \quad \mathrm{R}_{1}=$

11. $\mathrm{V}_{\mathrm{R}}=$ $\qquad$

12. $I_{R}=$

13. $\quad I_{R}=$


Warning: If $\mathrm{I}_{\mathrm{D}}$ 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 $\mathrm{D}_{1}$ does conduct. Assume that diode $\mathrm{D}_{2}$ does NOT conduct.
a) Find $\mathrm{V}_{\mathrm{R} 1}, \mathrm{I}_{\mathrm{R} 1}, \mathrm{I}_{\mathrm{R} 3}, \mathrm{I}_{\mathrm{D} 1}, \mathrm{~V}_{\mathrm{R} 2}$ based on these assumptions.

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

$$
\begin{array}{lll}
\mathrm{V}_{\mathrm{R} 1}=? & \mathrm{I}_{\mathrm{R} 1}=? & \mathrm{I}_{\mathrm{R} 3}=? \\
\mathrm{~V}_{\mathrm{R} 2}=? & &
\end{array}
$$

$\mathrm{V}_{\text {in }}:=4 \cdot \mathrm{~V}$

b) Was the assumption about $D_{1}$ correct? yes or no

ECE 2210 homework \# 22 p. 4
How do you know? (Specifically show a value which is or is not within a correct range.)
c) Was the assumption about $\mathrm{D}_{2}$ 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 $\mathrm{D}_{2}$ does conduct.
Find $\mathrm{V}_{\mathrm{R} 2}, \mathrm{~V}_{\mathrm{R} 1}, \mathrm{I}_{\mathrm{R} 1}, \& \mathrm{I}_{\mathrm{D} 2}$, based on these assumptions.
Stick with these assumptions even if your answers come out absurd. Hint: think in nodal voltages.

$$
\mathrm{V}_{\mathrm{R} 2}=? \quad \mathrm{~V}_{\mathrm{R} 1}=? \quad \mathrm{I}_{\mathrm{R} 1}=? \quad \mathrm{I}_{\mathrm{D} 2}=?
$$


b) Based on your numbers above, does it look like the assumption about $\mathrm{D}_{1}$ 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 $\mathrm{D}_{2}$ was correct? yes or no How do you know?

## Answers

$1 \quad \mathrm{~V}_{\mathrm{D}}:=0.7 \cdot \mathrm{~V}^{2} \quad \mathrm{~V}_{\mathrm{R}}:=3.3 \cdot \mathrm{~V} \quad \mathrm{I}_{\mathrm{D}}:=10 \cdot \mathrm{~mA}$
2. $\mathrm{I}_{\mathrm{D}}:=0 \cdot \mathrm{~mA} \quad \mathrm{~V}_{\mathrm{D}}:=-4 \cdot \mathrm{~V} \quad \mathrm{~V}_{\mathrm{R}}:=0 \cdot \mathrm{~V}$
3. $\mathrm{V}_{\mathrm{D}}:=0.7 \cdot \mathrm{~V} \quad \mathrm{~V}_{\mathrm{R}}:=7.3 \cdot \mathrm{~V} \quad \mathrm{I}:=14.3 \cdot \mathrm{~mA}$
4. $\mathrm{I}:=0 \cdot \mathrm{~mA} \quad \mathrm{~V}_{\mathrm{D} 2}:=-8 \cdot \mathrm{~V} \quad \mathrm{~V}_{\mathrm{D} 1}:=0 \cdot \mathrm{~V} \quad \mathrm{~V}_{\mathrm{R}}:=0 \cdot \mathrm{~V}$
5. $\mathrm{V}_{\mathrm{D} 1}:=0.7 \cdot \mathrm{~V} \quad \mathrm{~V}_{\mathrm{D} 2}:=-1.3 \cdot \mathrm{~V} \quad \mathrm{I}_{1}:=42.3 \cdot \mathrm{~mA}$
$\mathrm{I}_{2}:=0 \cdot \mathrm{~mA}$
6. $\mathrm{I}_{\mathrm{D} 2}:=0 \cdot \mathrm{~mA} \quad \mathrm{~V}_{\mathrm{D} 1}:=0.7 \cdot \mathrm{~V} \quad \mathrm{I}_{\mathrm{R} 2}:=13.8 \cdot \mathrm{~mA} \quad \mathrm{I}_{\mathrm{R} 1}=\mathrm{I}_{\mathrm{R} 3}:=9.83 \cdot \mathrm{~mA} \quad \mathrm{~V}_{\mathrm{D} 2}:=-2.17 \cdot \mathrm{~V} \quad \mathrm{I}_{\mathrm{D} 1}=\mathrm{I}_{\mathrm{T}}:=23.6 \cdot \mathrm{~mA}$
7. $\mathrm{V}_{\mathrm{D} 1}:=0.7 \cdot \mathrm{~V} \quad \mathrm{~V}_{\mathrm{D} 2}:=0.7 \cdot \mathrm{~V} \quad \mathrm{I}_{\mathrm{R} 1}:=0 \cdot \mathrm{~mA}$
$\mathrm{I}_{\mathrm{R} 2}:=13.8 \cdot \mathrm{~mA}=\mathrm{I}_{\mathrm{D} 1} \quad \mathrm{I}_{\mathrm{R} 3}:=11.3 \cdot \mathrm{~mA}=\mathrm{I}_{\mathrm{D} 2} \quad \mathrm{I}_{\mathrm{T}}:=25.1 \cdot \mathrm{~mA}$
8. $\mathrm{V}_{\mathrm{R}}:=4 \cdot \mathrm{~V} \quad \mathrm{R}:=267 \cdot \Omega$
9. $\mathrm{R}:=500 \cdot \Omega$
10. $\mathrm{R}_{1}:=233 \cdot \Omega \quad \mathrm{R}_{3}:=150 \cdot \Omega$
11. $\mathrm{V}_{\mathrm{R}}:=6 \cdot \mathrm{~V} \quad \mathrm{I}_{\mathrm{D}}:=50 \cdot \mathrm{~mA} \quad \mathrm{R}:=120 \cdot \Omega \quad \mathrm{P}_{\mathrm{R}}:=0.3 \cdot \mathrm{~W} \quad \mathrm{P}_{\mathrm{D}}:=0.6 \cdot \mathrm{~W}$
12. $\mathrm{I}_{\mathrm{L}}:=40 \cdot \mathrm{~mA} \quad \mathrm{I}_{\mathrm{R}}:=50 \cdot \mathrm{~mA} \quad \mathrm{I}_{\mathrm{D}}:=10 \cdot \mathrm{~mA} \quad \mathrm{P}_{\mathrm{R}}:=0.3 \cdot \mathrm{~W} \quad \mathrm{P}_{\mathrm{D}}:=0.12 \cdot \mathrm{~W}$
13. $\mathrm{I}_{\mathrm{D}}:=0 \cdot \mathrm{~mA} \quad \mathrm{I}_{\mathrm{L}}=\mathrm{I}_{\mathrm{R}}:=56.3 \cdot \mathrm{~mA} \quad \mathrm{~V}_{\mathrm{L}}:=11.3 \cdot \mathrm{~V} \quad \mathrm{P}_{\mathrm{R}}:=0.38 \cdot \mathrm{~W} \quad \mathrm{P}_{\mathrm{D}}:=0 \cdot \mathrm{~W}$
14. a) $\mathrm{V}_{\mathrm{R} 1}:=0.7 \cdot \mathrm{~V}^{2} \quad \mathrm{I}_{\mathrm{R} 1}:=14 \cdot \mathrm{~mA} \quad \mathrm{I}_{\mathrm{R} 3}:=6 \cdot \mathrm{~mA} \quad \mathrm{I}_{\mathrm{D} 1}:=-8 \cdot \mathrm{~mA} \quad \mathrm{~V}_{\mathrm{R} 2}:=0.9 \cdot \mathrm{~V} \quad$ b) $\quad$ no $\quad \mathrm{I}_{\mathrm{D} 1}=-8 \cdot \mathrm{~mA}<0$
c) no $\mathrm{V}_{\mathrm{D} 2}=\mathrm{V}_{\mathrm{R} 2}=0.9 \cdot \mathrm{~V}>0.7 \mathrm{~V}$
15. a) $\mathrm{V}_{\mathrm{R} 2}:=1.8 \cdot \mathrm{VV}_{\mathrm{R} 1}:=1.2 \cdot \mathrm{~V}_{\mathrm{R} 1}:=24 \cdot \mathrm{~mA} \quad \mathrm{I}_{\mathrm{D} 2}:=-4 \cdot \mathrm{~mA}$
b) no $\quad \mathrm{V}_{\mathrm{D} 1}=\mathrm{V}_{\mathrm{R} 1}=1.2 \cdot \mathrm{~V}>0.7 \mathrm{~V}$

ECE 2210 homework \# 22 p. 4
c) no $\mathrm{I}_{\mathrm{D} 2}=-4 \cdot \mathrm{~mA}<0$

