Homework 3 Solutions

1. Problem 2, p. 818 (all problems taken from Rosen text).

   (a) $x = 0$, as in $0 \cdot 1 = 0$.

   (b) $x = 0$, as in $0 + 0 = 0$.

   (c) $x = 0|1$; that is, x can be either 0 or 1:
   $0 \cdot 1 = 0$ and $1 \cdot 1 = 1$

   (d) Can't be done.

2. Problem 5, part c, p. 818.

x	y	z	$x\bar{y}$	$\overline{xyz}$	$x\bar{y} + \overline{xyz}$
1	1	1	0	0	0
1	1	0	0	1	1
1	0	1	1	1	1
1	0	0	1	1	1
0	1	1	0	1	1
0	1	0	0	1	1
0	0	1	0	1	1
0	0	0	0	1	1

3. Problem 1, p. 822.

   (a) $\bar{x}\bar{y}z$

   (b) $\bar{x}y\bar{z}$

   (c) $\bar{x}yz$

   (d) $\bar{x}\bar{y}\bar{z}$
   Note that this is **not** the same as $\overline{xyz}$. Write a truth table if you're not convinced.

4. Problem 2, p. 822.

   These can be solved in different ways; see below.

   (a) Solving this using Boolean algebra rules:

$$\begin{aligned} \bar{x} + y &= \bar{x}(\bar{y} + y) + y(\bar{x} + x) \\ &= \bar{x}\bar{y} + \bar{x}y + y\bar{x} + yx \\ &= \bar{x}\bar{y} + \bar{x}y + yx \end{aligned}$$

(b) This is already a sum-of-products expression!

(c) Any combination of 0s and 1s must result in a 1, so:

$xy + \bar{x}y + x\bar{y} + \bar{x}\bar{y}$

(d) Solving this using a truth table:

x	y	$\bar{y}$
1	1	0
1	0	1
0	1	0
0	0	1

Looking at the rows where the result is a 1 gives us:

$x\bar{y} + \bar{x}\bar{y}$

5. Problem 3, p. 822.

(a) Using a truth table:

x	y	z	$x + y + z$
1	1	1	1
1	1	0	1
1	0	1	1
1	0	0	1
0	1	1	1
0	1	0	1
0	0	1	1
0	0	0	0

Thus, we need all combinations of the three variables except when they are all false:

$xyz + xy\bar{z} + x\bar{y}z + x\bar{y}\bar{z} + \bar{x}yz + \bar{x}y\bar{z} + \bar{x}\bar{y}z$

(b) $(x + z)y = xy + zy$

6. Problem 1, p. 827.

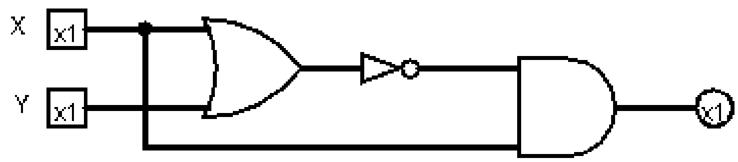
$(x + y)\bar{y}$

7. Problem 3, p. 827.

$\overline{xy} + (\bar{z} + x)$

8. Problem 6, p. 828.

   (b)



   (d)