Homework #1
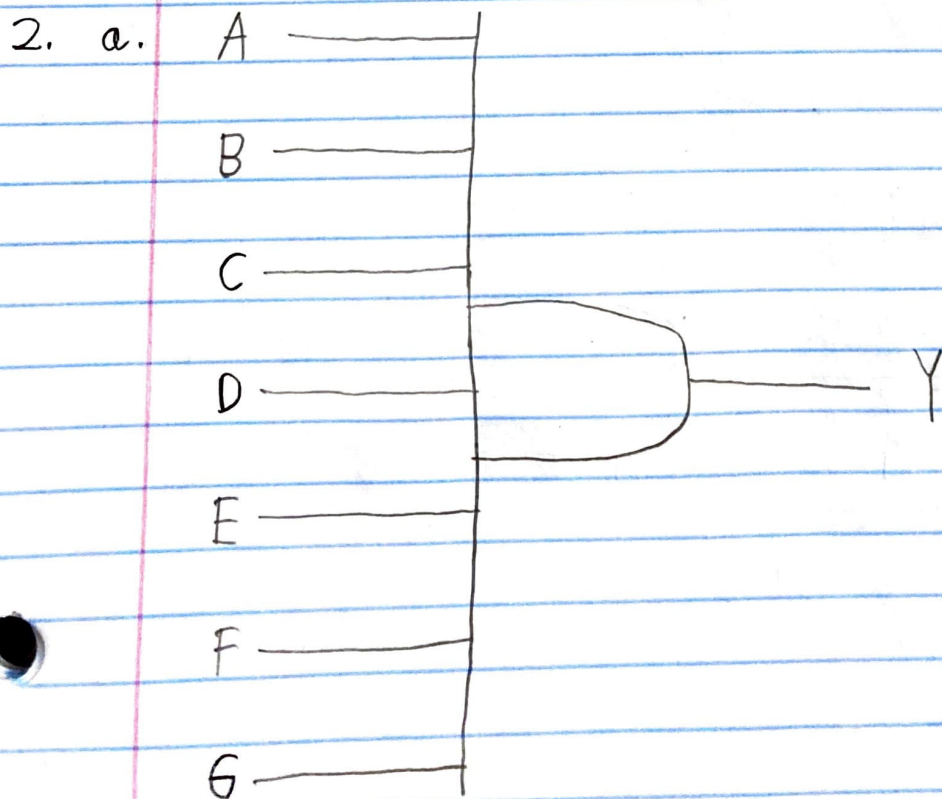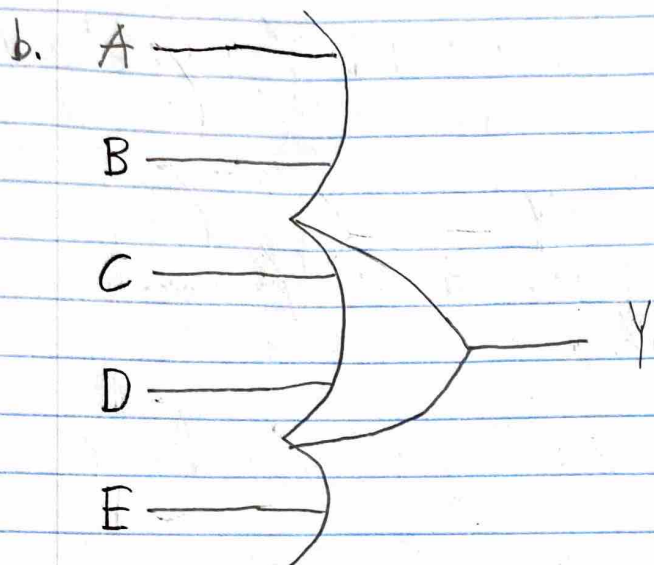
1. a. $(001100)_2 = 0 \cdot 2^5 + 0 \cdot 2^4 + 1 \cdot 2^3 + 1 \cdot 2^2 + 0 \cdot 2^1 + 0 \cdot 2^0$

$$= (12)_{10}$$

b. $(11100)_2 = 1 \cdot 2^4 + 1 \cdot 2^3 + 1 \cdot 2^2 + 0 \cdot 2^1 + 0 \cdot 2^0$

$$= (28)_{10}$$

c. $(000111100)_2$

$= 0 \cdot 2^8 + 0 \cdot 2^7 + 0 \cdot 2^6 + 1 \cdot 2^5 + 1 \cdot 2^4 + 1 \cdot 2^3 + 1 \cdot 2^2$
$+ 0 \cdot 2^1 + 0 \cdot 2^0$

$$= (60)_{10}$$

d. $(101010)_2 = 1 \cdot 2^5 + 0 \cdot 2^4 + 1 \cdot 2^3 + 0 \cdot 2^2 + 1 \cdot 2^1 + 0 \cdot 2^0$

$$= (42)_{10}$$

2. a.

b.

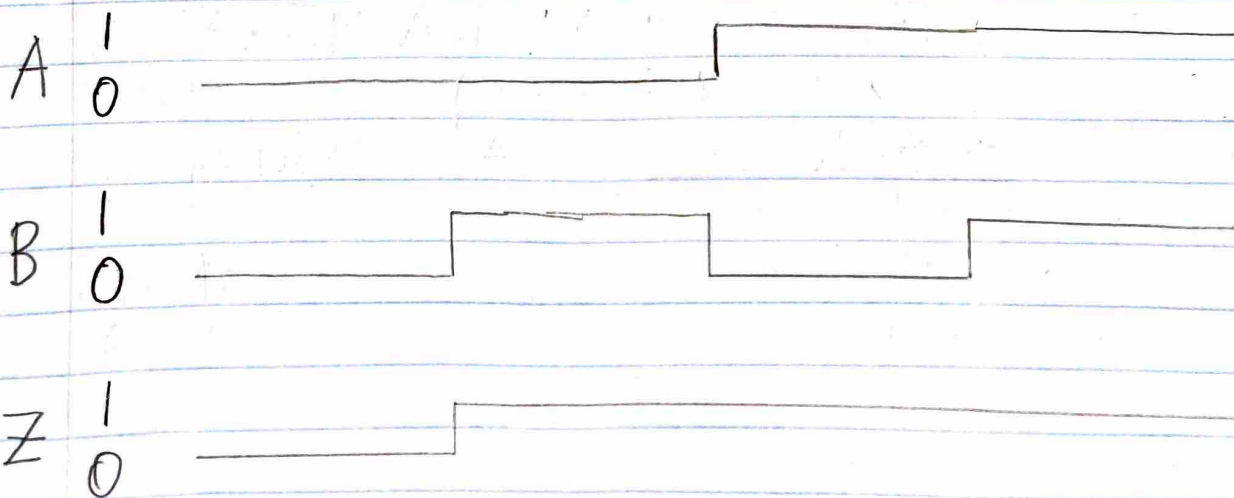3. Circuit I:

$$Z = \overline{A}(A+B) + (A+B) = (\overline{A}+1)\cdot(A+B) = 1\cdot(A+B) = A+B$$

Truth Table:

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	1

Timing Diagram:

3.   Circuit II:

$$X = \overline{A} \cdot \overline{B} + A \cdot B$$

Truth Table:

A	B	X
0	0	1
0	1	0
1	0	0
1	1	1

Timing Diagram:

A   1   0

B   1   0

X   1   0
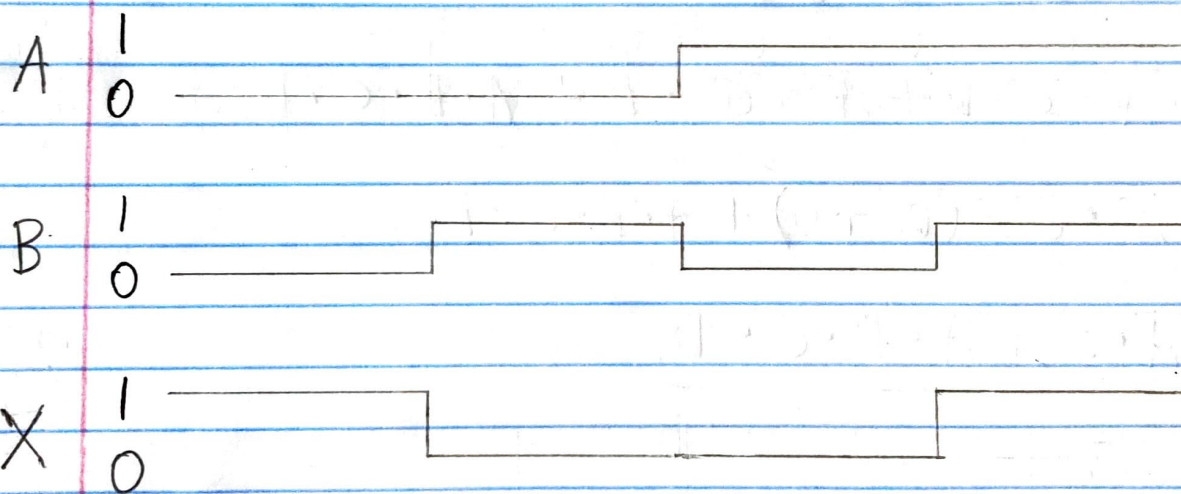
4.   a. $Y = \overline{A} \cdot \overline{B} \cdot \overline{C} + A \cdot \overline{B} \cdot \overline{C} + \overline{A} \cdot B \cdot \overline{C}$

$= (\overline{A} + A) \cdot \overline{B} \cdot \overline{C} + \overline{A} \cdot B \cdot \overline{C}$

$= \overline{B} \cdot \overline{C} + \overline{A} \cdot B \cdot \overline{C}$

$= \overline{C} \cdot (\overline{B} + \overline{A} \cdot B)$

$= \overline{C} \cdot (\overline{B} + B \cdot \overline{A})$

$= \overline{C} \cdot (\overline{B} + \overline{\overline{B}} \cdot \overline{A})$

$= \overline{C} \cdot (\overline{B} + \overline{A})$

$= \overline{A} \cdot \overline{C} + \overline{B} \cdot \overline{C}$

b.

AB \ C	0	1
00	1	0
01	1	0
10	1	0
11	0	0

$$Y = \overline{A} \cdot \overline{C} + \overline{B} \cdot \overline{C}$$

5. c.
$$Y = \overline{A} \cdot \overline{B} \cdot \overline{C} \cdot \overline{D} + \overline{A} \cdot B \cdot \overline{C} \cdot \overline{D} + \overline{A} \cdot \overline{B} \cdot \overline{C} \cdot D$$
$$+ \overline{A} \cdot B \cdot \overline{C} \cdot D + A \cdot B \cdot C \cdot D$$

$$= (\overline{B} + B) \cdot \overline{A} \cdot \overline{C} \cdot \overline{D} + (\overline{B} + B) \cdot \overline{A} \cdot \overline{C} \cdot D$$
$$+ A \cdot B \cdot C \cdot D$$

$$= \overline{A} \cdot \overline{C} \cdot \overline{D} + \overline{A} \cdot \overline{C} \cdot D + A \cdot B \cdot C \cdot D$$

$$= \overline{A} \cdot \overline{C} \cdot (\overline{D} + D) + A \cdot B \cdot C \cdot D$$

$$= \overline{A} \cdot \overline{C} + A \cdot B \cdot C \cdot D$$

d.

CD \ AB	00	01	11	10
00	1	1	0	0
01	1	1	0	0
11	0	0	1	0
10	0	0	0	0

$$Y = \overline{A} \cdot \overline{C} + A \cdot B \cdot C \cdot D$$