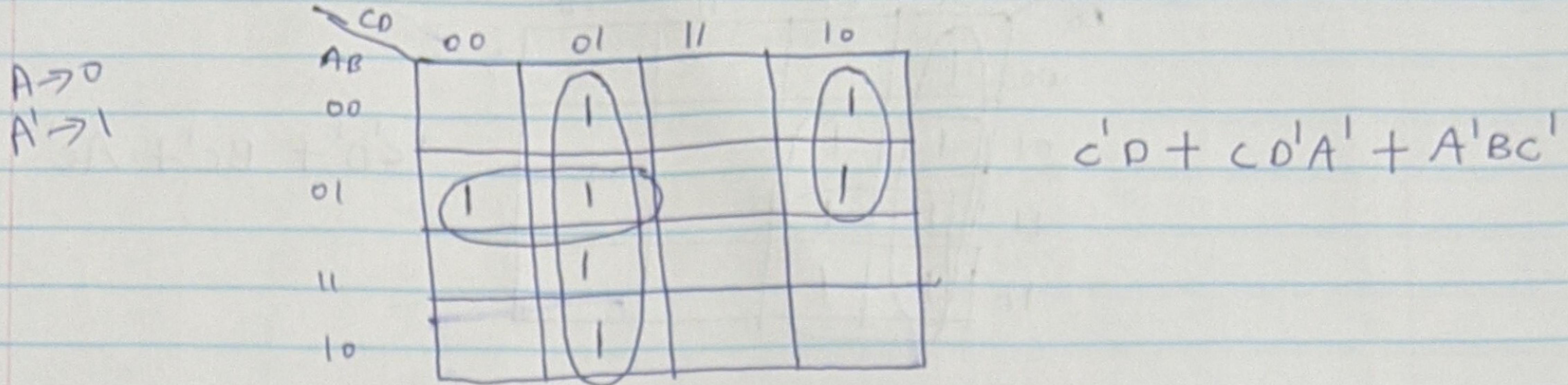
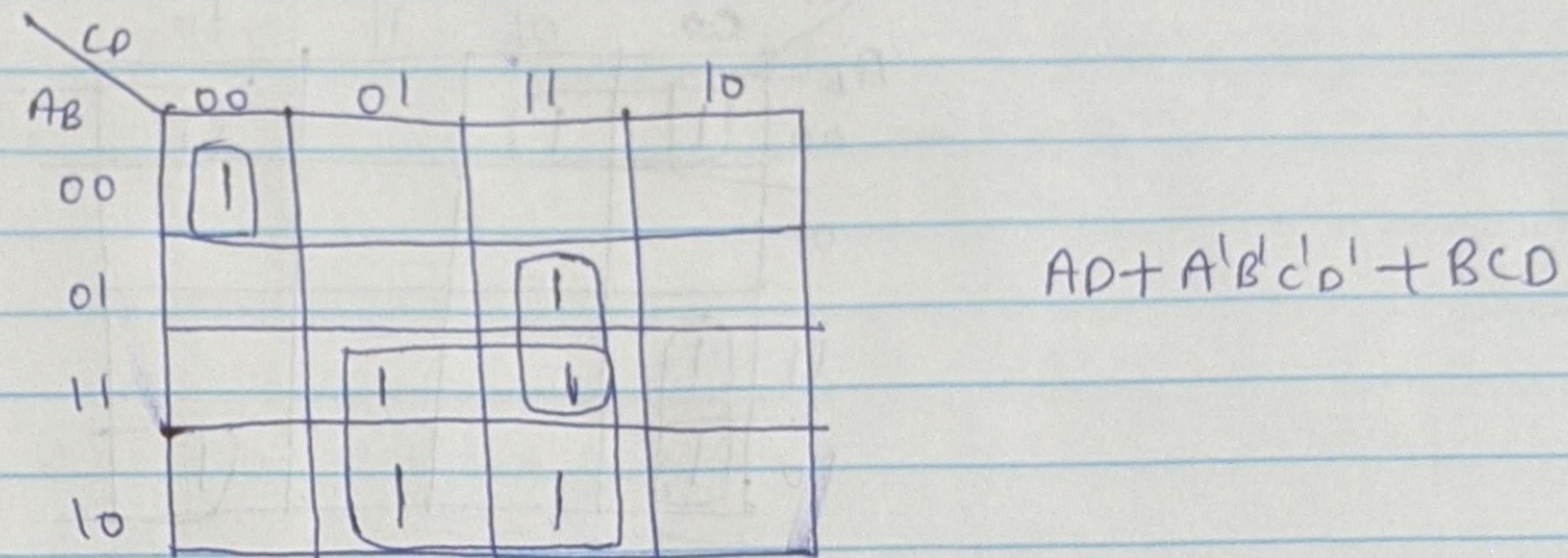


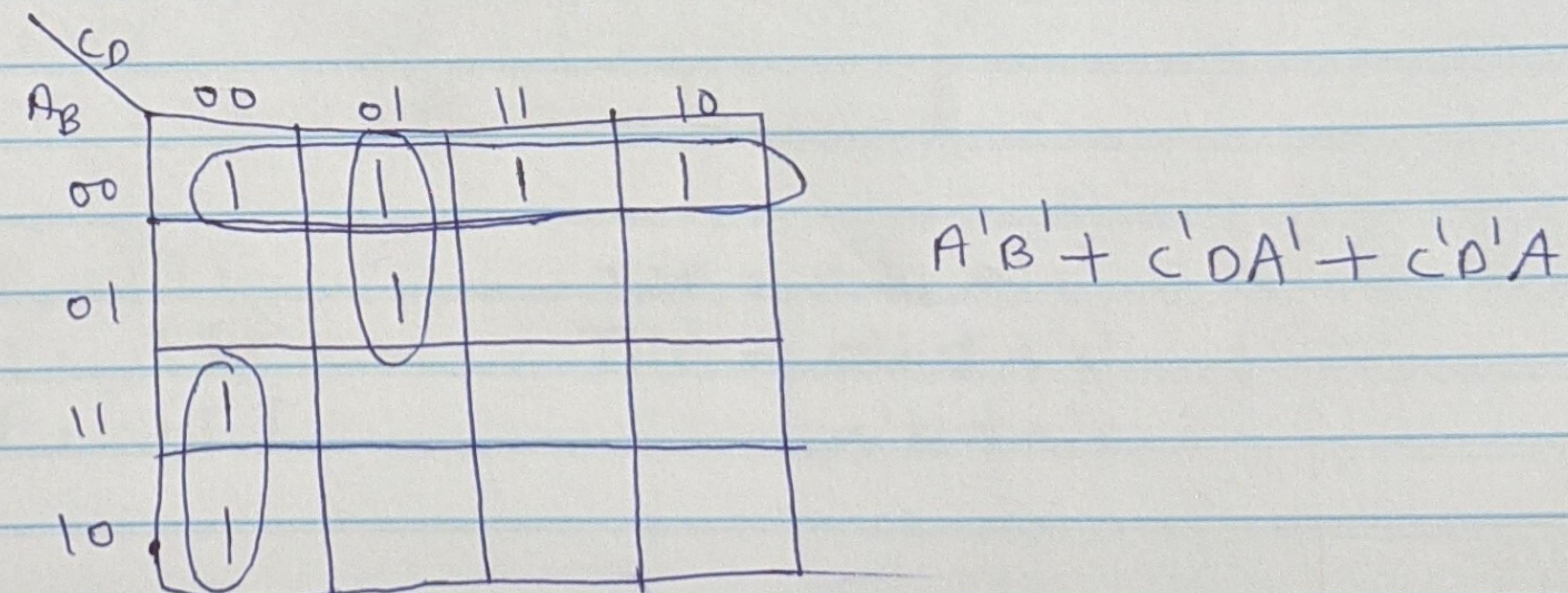
Q.3 (a)  $a'b'd' + a'c'd + ac'd + a'cd'$   
 $a'b'd'c + a'b'd'c' + a'c'd(b + a'c'db') + ac'db + ac'db' + a'cd'b + a'cd'b'$



(b)  $a'b'c'd' + ab'c'd + ab'cd + a'b'cd + abc'd + abcd$



(c)  $a'b' + a'bc'd + a'c'd'$   
 $a'b'c + a'b'c' + a'bc'd + ac'd'b + ac'd'b'$   
 $a'b'cd + a'b'cd' + a'b'c'd + a'b'c'd' + a'bc'd + ac'd'b + ac'd'b'$



$$(d) abc'd + a'b'c'd' + ab'c'd' + abc'd' + a'b'c'd + ab'c'd + a'b'c'd'$$

|    |    | CD | 00 | 01 | 11 | 10 |
|----|----|----|----|----|----|----|
|    |    | AB | 00 | 01 | 11 | 10 |
| CD | AB | 00 | 1  |    |    |    |
|    |    | 01 | 1  | 1  |    |    |
| CD | AB | 11 | 1  | 1  |    |    |
|    |    | 10 | 1  | 1  |    |    |

$$c'd' + Bc' + Ac'$$

$$(e) a'b'c'd' + ab'c'd' + ab'cd' + a'b'cd' + abc'd' + a'b'c'd$$

|    |    | CD | 00 | 01 | 11 | 10 |
|----|----|----|----|----|----|----|
|    |    | AB | 00 | 01 | 11 | 10 |
| CD | AB | 00 | 1  | 1  |    | 1  |
|    |    | 01 |    |    |    |    |
| CD | AB | 11 | 1  |    |    |    |
|    |    | 10 | 1  |    |    | 1  |

$$B'd' + AB'c' + c'b'A$$

$$(4) (a) a'b + c'$$

| a | b | c | $a'b + c'$ |
|---|---|---|------------|
| F | F | F | F          |
| F | F | T | T          |
| F | T | F | F          |
| F | T | T | T          |
| T | F | F | F          |
| T | F | T | F          |
| T | T | F | F          |
| T | T | T | F          |

$c/d$

$$c/d = \text{FFF, TTT}$$

$$c = \text{FTT, TFF}$$

$$d = \text{FFF, FFT}$$

$$\text{TOF} = a'b', c'$$

$$\text{TNF} = a + b' + c',$$

$$a'b + c$$

$$(b) a'(b+c')$$

| a | b | c | $a'b + a'c'$ |
|---|---|---|--------------|
| F | F | F | F            |
| F | F | T | T            |
| F | T | F | F            |
| F | T | T | T            |
| T | F | F | F            |
| T | F | T | F            |
| T | T | F | F            |
| T | T | T | F            |

$c/d$

$$c/d = \text{FFF, TTT}$$

$$c = \text{FFT, TTF}$$

$$d = \text{FFF, FFT}$$

$$\text{TOF} = a'b, a'c'$$

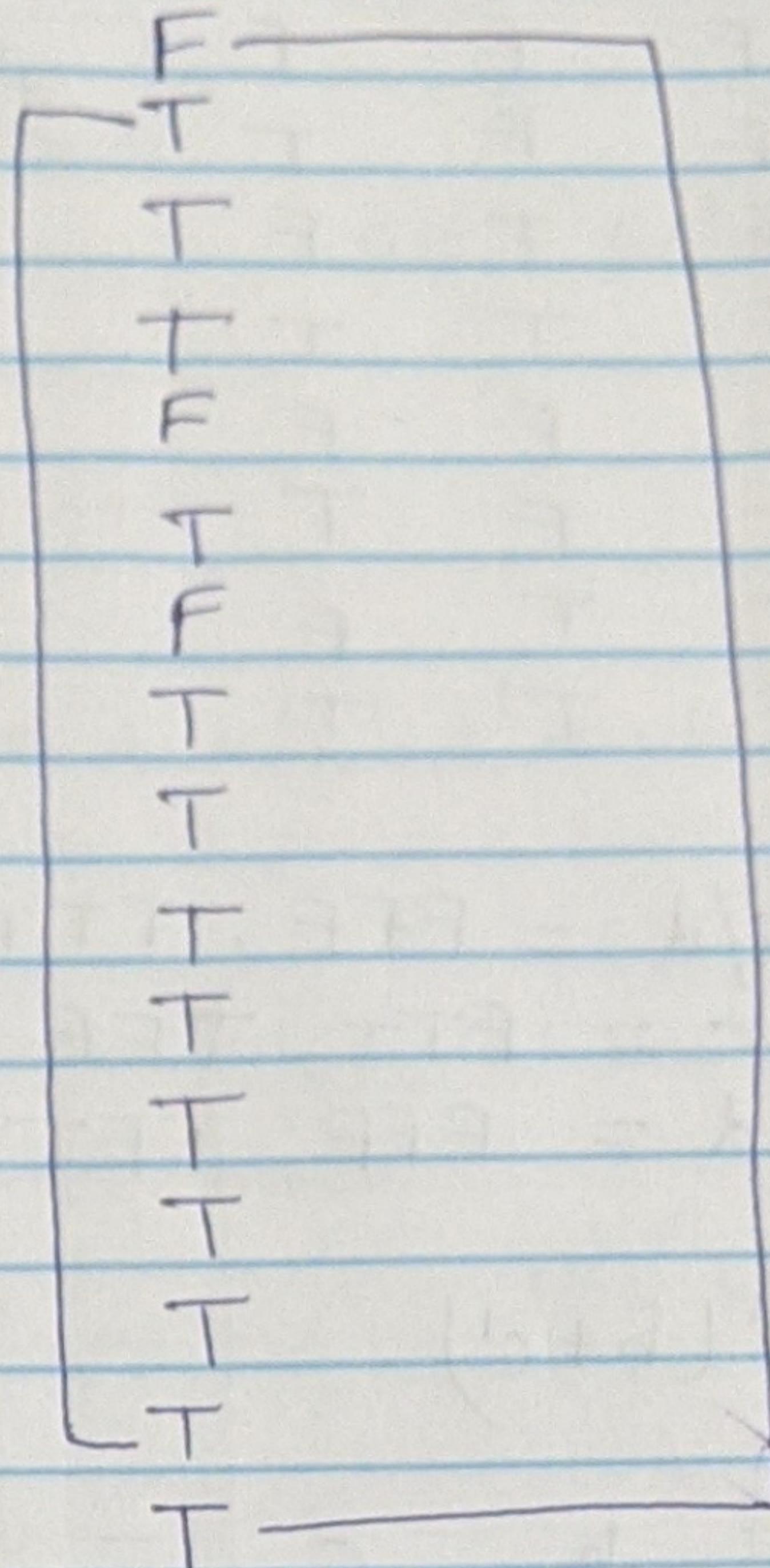
$$\text{TNF} = a + b + a'c'$$

$$a'b + a'c$$

(c)  $a + b'c + d$

| $a$ | $b$ | $c$ | $d$ |
|-----|-----|-----|-----|
| F   | F   | F   | F   |
| F   | F   | F   | T   |
| F   | F   | T   | F   |
| F   | F   | T   | T   |
| F   | T   | F   | F   |
| F   | T   | F   | T   |
| F   | T   | T   | F   |
| F   | T   | T   | T   |
| T   | F   | F   | F   |
| T   | F   | F   | T   |
| T   | F   | T   | F   |
| T   | F   | T   | T   |
| T   | T   | F   | F   |
| T   | T   | F   | T   |
| T   | T   | T   | F   |
| T   | T   | T   | T   |

$a + b'c + d$



$c|d$

$c|d \rightarrow FFFF, TTTT$

$c \rightarrow FFFT, TTTF$

$d \rightarrow FFFF, FFTT$

$T_0F \rightarrow b'c + d, a + d, a + b'c$

$TNF \Rightarrow a' + b'c + d, a + b + c' + d, a + b'c + d'$

$$\begin{aligned}
 & (d) (ab \text{ XOR } cd) + abcd \\
 & (ab)'cd + ab(cd)' + abcd \\
 & (a'+b')cd + ab(c'+d') + abcd \\
 & a'cd + b'cd + abc' + abd' + abcd \\
 & = ab + cd
 \end{aligned}$$

| a | b | c | d | $ab + cd$ |
|---|---|---|---|-----------|
| F | F | F | F | F         |
| F | F | F | T | F         |
| F | F | T | F | F         |
| F | F | T | T | T         |
| F | T | F | F | F         |
| F | T | F | T | F         |
| F | T | T | F | F         |
| T | F | F | F | T         |
| T | F | T | F | F         |
| T | F | T | T | T         |
| T | T | F | F | F         |
| T | T | F | T | T         |
| T | T | F | F | T         |
| T | T | T | T | T         |
| T | T | T | F | F         |
| T | T | F | T | T         |
| T | T | T | F | F         |
| T | T | T | T | T         |

cld  $\Rightarrow$  FFFF, TTTT

$c \rightarrow FFT, TFF$

$d \rightarrow \underline{\text{FFFF}}, \text{ FFTT}$

TOF  $\rightarrow$  ab, cd

$$\text{TNF} \rightarrow ab + c' + d', \quad a' + b' + cd$$

(5)

$$(1) (a) a = (b < 10) \parallel c'$$

 $T \rightarrow q$ 
 $F \rightarrow 10$ 

| Test Case | Inputs |   | Expected output |
|-----------|--------|---|-----------------|
|           | b      | c | a               |
| 1. FT     | 10     | T | T               |
| 2. TT     | q      | T | T               |
| 3. FF     | 10     | F | F               |

$$(b) a = b' \parallel (c > 4)$$

$$a+b \rightarrow FF, TF, FT$$

 $\text{For } c \rightarrow T \rightarrow 4$ 

$$a'+b \rightarrow TF, FF, TT$$

 $F \rightarrow 3$ 

| Test Case | Input |   | Expected output |
|-----------|-------|---|-----------------|
|           | b     | c | a               |
| 1. TF     | T     | 3 | T               |
| 2. FF     | F     | 3 | F               |
| 3. TT     | T     | 4 | T               |

$$(c) a = (b <= 8) \wedge (c > 8)$$

$$a \wedge b \rightarrow TT, FT, TF$$

 $\text{for } b \rightarrow T \rightarrow 8$ 
 $F \rightarrow 9$ 
 $\text{for } c \rightarrow T \rightarrow 9$ 
 $F \rightarrow 8$ 

| Test Case | Inputs |   | Expected output |
|-----------|--------|---|-----------------|
|           | b      | c | a               |
| 1. TT     | 8      | 9 | T               |
| 2. FT     | 9      | 9 | F               |
| 3. TF     | 8      | 8 | F               |

$$(d) a = (b >= 2) \& (b < 8)$$

$$\Rightarrow 2 \leq b \leq 7$$

| Test Case | Input<br>b | Output<br>a |
|-----------|------------|-------------|
| 1         | 1          | F           |
| 2         | 2          | T           |
| 3         | 8          | F           |
| 4         | 7          | T           |

2.

$$(a) a' b + c$$

$$COT_a = XTF \rightarrow FFF, FTE, TTF$$

$$b = FXF$$

$$c = FFX, TFX, TTX$$

$$BS - FFF, FTE, TTF$$

$$VC - FFF, FTE, TTF, FFT$$

$$(b) a' (c+d')$$

$$\Rightarrow a'c + a'd'$$

$$COT_a = XTT, XFF$$

$$c = FXT$$

$$d = FFX \rightarrow FFF, FFT, FTT$$

$$BS = FFF, FFT, FTT$$

$$VC = FFF, FFT, FTT, TTT, TFF$$

(c)  $a + b'c + d$

$C_0 T_a = XTTF, XFFF, XTFF$

$b = FXTF \rightarrow FFFF, FFTF, FTTF$

$c = FFXF \rightarrow FFFF, FFTF, FTTF$

$d = FTIX, FTEX, FFFX$

$BS = FFFF, FFTF, FTTF$

$VC = FFFF, FFTF, FTTF, TTTF, FFFT$

$$(3) \quad ab'c + d'$$

$$C_0 T = XFTT$$

$$\overset{a}{b} = TXTT \rightarrow TFTT, TTTT, TFFT, FFTT$$

$$c = TFXT$$

$$BS = TFTT, TTTT, TFFT, FFTT$$

$$VC_1 = TFTT, TTTT, TFFT, FFTT, TFFF$$

$$VC_2 = TFTT, TTTT, TFFT, FFTT, TTTF$$

$$M_1 = TFTT, TTTT, TFFT, FFTT, FFFF$$