

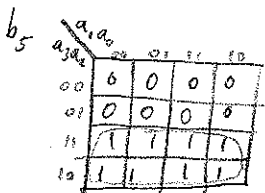
3(d)(10 points) Provide a truth table where the input is  $x = (a_3 a_2 a_1 a_0)_2$  and the output is  $f(x) = 2x - 3 = (b_n b_{n-1} \dots b_0)_2$ , where  $n$  is determined from your answer in 3(c).

$a_3$	$a_2$	$a_1$	$a_0$	$f(x)_{dec}$
7	0	1	1	11
6	0	1	1	0
5	0	1	0	1
4	0	1	0	0
3	0	0	1	1
2	0	0	1	0
1	0	0	0	1
0	0	0	0	0
-1	1	1	1	-5
-2	1	1	1	0
-3	1	1	0	1
-4	1	1	0	0
-5	1	0	1	-13
-6	1	0	1	0
-7	1	0	0	1
-8	1	0	0	0

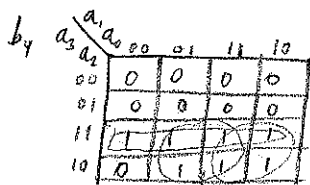
  

$a_3$	$a_2$	$a_1$	$a_0$	$b_5$	$b_4$	$b_3$	$b_2$	$b_1$	$b_0$
0	0	0	0	1	1	1	1	0	1
0	0	0	1	1	1	1	1	0	1
0	0	1	0	0	0	0	0	0	1
0	0	1	1	0	0	0	0	0	1
0	1	0	0	0	0	0	0	1	1
0	1	0	1	0	0	0	0	1	1
0	1	1	0	0	0	1	0	0	1
0	1	1	1	0	0	1	0	0	1
1	0	0	0	1	0	1	1	0	1
1	0	0	1	1	0	1	1	0	1
1	0	1	0	1	1	0	0	0	1
1	1	0	0	1	1	0	0	0	1
1	1	0	1	1	1	0	0	0	1
1	1	1	0	1	1	1	0	1	1
1	1	1	1	1	1	1	0	1	1

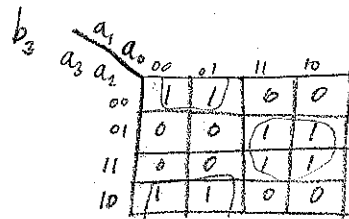
3(e)(10 points) Use four-variable Karnaugh maps to determine minimum sums of products for each one of  $(b_n b_{n-1} \dots b_0)_2$ .



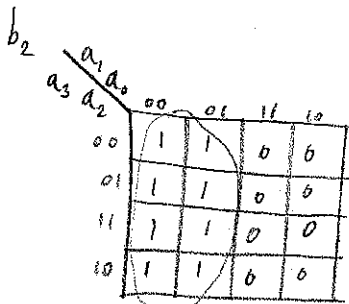
$F = a_3$



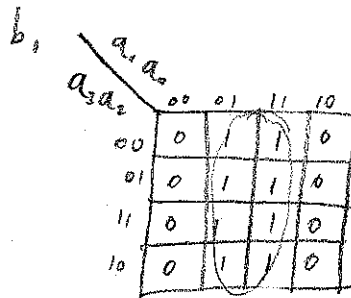
$F = a_3 a_2 + a_3 a_0 + a_3 a_1$



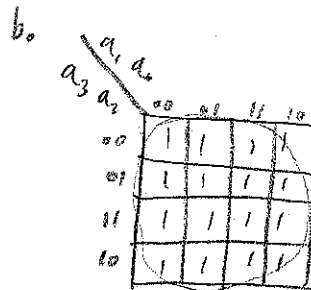
$F = \bar{a}_2 \bar{a}_1 + a_2 a_1$



$F = \bar{a}_1$



$F = a_0$



$F = 1$

**Problem 4(10 points)**

Use a 4-to-1 multiplexer and any additional gates to realize the following four-variable function:

$$F(A, B, C, D) = \sum m(0, 4, 6, 9, 11)$$

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

$$F = \bar{A}\bar{C}D + \bar{A}B\bar{D} + A\bar{B}D$$

	$S_1$	$S_0$	A	B	C	D	F
0	0	0	0	0	0	0	1
1	0	0	0	1	0	0	0
2	0	1	0	0	1	0	1
3	0	1	0	1	1	0	0
4	1	0	0	0	0	0	0
5	1	0	0	1	0	0	1
6	1	0	1	0	0	0	0
7	1	0	1	1	0	0	1
8	1	1	0	0	0	0	0
9	1	1	0	1	0	0	0
10	1	1	1	0	0	0	0
11	1	1	1	1	0	0	0

$$F = \bar{C}D$$

$$F = \bar{D}$$

$$F = D$$

$$F = 0$$

	D	
C	0	1
0	1	0
1	0	1

$$F = \bar{C}D + CD$$
