ASCII Character Conversion

CHAR	HEX	OCTAL	BINARY	DEC
A	41	101	01000001	065
B	42	102	01000010	066
C	43	103	01000011	067
D	44	104	01000100	068
E	45	105	01000101	069
F	46	106	01000110	070
G	47	107	01000111	071
H	48	110	01001000	072
I	49	111	01001001	073
J	4A	112	01001010	074
K	4B	113	01001011	075
L	4C	114	01001100	076
M	4D	115	01001101	077
N	4E	116	01001110	078
O	4F	117	01001111	079
P	50	120	01010000	080
Q	51	121	01010001	081
R	52	122	01010010	082
S	53	123	01010011	083
T	54	124	01010100	084
U	55	125	01010101	085
V	56	126	01010110	086
W	57	127	01010111	087
X	58	130	01011000	088
Y	59	131	01011001	089
Z	5A	132	01011010	090
a	61	141	01100001	097
b	62	142	01100010	098
c	63	143	01100011	099
d	64	144	01100100	100
e	65	145	01100101	101
f	66	146	01100110	102
g	67	147	01100111	103
h	68	150	01101000	104
i	69	151	01101001	105
j	6A	152	01101010	106
k	6B	153	01101011	107
l	6C	154	01101100	108
m	6D	155	01101101	109
n	6E	156	01101110	110
o	6F	157	01101111	111
p	70	160	01110000	112
q	71	161	01110001	113
r	72	162	01110010	114
s	73	163	01110011	115
t	74	164	01110100	116
u	75	165	01110101	117
v	76	166	01110110	118
w	77	167	01110111	119
x	78	170	01111000	120
y	79	171	01111001	121
z	7A	172	01111010	122
0	30	060	00110000	048
1	31	061	00110001	049
2	32	062	00110010	050
3	33	063	00110011	051
4	34	064	00110100	052
5	35	065	00110101	053
6	36	066	00110110	054
7	37	067	00110111	055
8	38	070	00111000	056
9	39	071	00111001	057
SP	20	040	00100000	032
!	21	041	00100001	033
"	22	042	00100010	034
#	23	043	00100011	035
$	24	044	00100100	036
>	3E	076	00111110	062
?	3F	077	00111111	063
%	25	045	00100101	037
&	26	046	00100110	038
'	27	047	00100111	039
(	28	050	00101000	040
)	29	051	00101001	041
*	2A	052	00101010	042
+	2B	053	00101011	043
,	2C	054	00101100	044
-	2D	055	00101101	045
.	2E	056	00101110	046
/	2F	057	00101111	047
:	3A	072	00111010	058
;	3B	073	00111011	059
<	3C	074	00111100	060
=	3D	075	00111101	061
STX	02	002	00000010	002
ETX	03	003	00000011	003

CHAR	HEX	OCTAL	BINARY	DEC
@	40	100	01000000	064
[	5B	133	01011011	091
\	5C	134	01011100	092
]	5D	135	01011101	093
^	5E	136	01011110	094
	5F	137	01011111	095
{	7B	173	01111011	123
|	7C	174	01111100	124
}	7D	175	01111101	125
~	7E	176	01111110	126
DEL	7F	177	01111111	127
NUL	00	000	00000000	000
SOH	01	001	00000001	001
D1	11	021	00010001	017
D2	12	022	00010010	018
D3	13	023	00010011	019
D4	14	024	00010100	020
NAK	15	025	00010101	021
SYN	16	026	00010110	022
ETB	17	027	00010111	023
CAN	18	030	00011000	024
EM	09	031	00011001	025
SUB	1A	032	00011010	026
ESC	1B	033	00011011	027
FS	1C	034	00011100	028
GS	1D	035	00011101	029
RS	1E	036	00011110	030
US	1F	037	00011111	031

CHAR	HEX	OCTAL	BINARY	DEC
EOT	04	004	00000100	004
ENQ	05	005	00000101	005
ACK	06	006	00000110	006
BEL	07	007	00000111	007
BS	08	010	00001000	008
HT	09	011	00001001	009
LF	0A	012	00001010	010
VT	0B	013	00001011	011
FF	0C	014	00001100	012
CR	0D	015	00001101	013
SO	0E	016	00001110	014
SI	0F	017	00001111	015
DLE	10	020	00010000	016

32 - 126

33 - 126

2^0	1
2^1	2
2^2	4
2^3	8
4	16
5	32
6	64
7	128
8	256
9	513
10	1024
11	2048
12	4096
13	8192
14	16384
15	32768
16	65536

Brayden Buchanan

* Base 2 8 bits
- 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0
- 8 bits = 1 byte
- 16 bits = word
- 32 bits = double word
- 64 bits = sentence
- 4 bits = nibble

* Base 10 Numbers
- 10^5 10^4 10^3 10^2 10^1 10^0
  4562 - $2 \cdot 10^0$, $6 \cdot 10^1$, $5 \cdot 10^2$, $4 \cdot 10^3$
* Base 16 Numbers - Hexadecimal
- 4562 - $2 \cdot 16^0$, $6 \cdot 16^1$, $5 \cdot 16^2$, $4 \cdot 16^3$
* Binary - Base 2
- 0 & 1
- adds to be 255, starts at 0

*	B_{10}	B_{16}	B_2
	0	0	0000
	1	1	0001
	2	2	0010
	3	3	0011
	4	4	0100
	5	5	0101
	6	6	0110
	7	7	0111
	8	8	1000
	9	9	1001
	10	A	1010
	11	B	1011
	12	C	1100
	13	D	1101
	14	E	1110
	15	F	1111

* Base 8
- 0-7

* * Decimal - Binary

* 1560 ÷ 2 = 780

780 ÷ 2 = 390

390 ÷ 2 = 195

195/2 = 97 r1

97/2 = 48 r1

48/2 = 24

24/2 = 12

12/2 = 6

6/2 = 3

3/2 = 1 r1

1/2 = 0 r1

- 11000011000

* 1560 11000011000

1560
-1024
536
512
24
16
8
8
0

* 16384 10000010000000

-16384
1152
1024
128
0
8
0

Computer Technology I

Name Brandon Buchanan

Convert the following digits from decimal (base 10) to binary (base 2)

1.) 73 — 1001001

2.) 2053 — 100000000101

3.) 2824 — 101100001000

4.) 1046 — 10000010110

5.) 4170 — 1000001001010

6.) 12330 — 11000000101010

7.) 41321 — 1010000101001001

8.) 37911 — 1001001000111011

9.) 30900 — 1111000010110100

10.) 65535 — 1111111111111111

Take the given number and divide by 2, write down remainder and place it furthest to the right. Repeat this process using the remainder until you are left with a zero . Hint : (you know you are doing it correctly if the answer you get is in the form of all ones or twos)

Example: 1028

1028/2=514 r=0, 514/2=257 r=0, 257/2=128 r=1, 128/2=64 r=0, 64/2=32 r=0, 32/2=16 r=0, 16/2=8 r=0, 8/2=4 r=0, 4/2=2 r=0, 2/2=1 r=0, 1/2=0 r1

answer: 10000000100

Written by: George Zima

Computer Technology I

Name Brandon Buchanan

Convert the following digits from binary (base 2) to decimal (base 10)

1.) 1010 — 10

2.) 11000011 — 195

3.) 00001100 — 12

4.) 10 — 2

5.) 00101111 — 47

6.) 1111 1111 — 255

7.) 1 0000 0000 0000 — 4096

8.) 1010 1010 1010 — 2730

9.) 101 1001 1100 1101 — 22989

10.) 1111 — 15

Place values

MSB ---------- LSB

2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1024	512	256	128	64	32	16	8	4	2	1

1. 73 — 1001001

-64

9

8

1

2. 2057 — 10000000101

-2048

5

4

1

1

0

3. 2814 — 101100001000

-2048

776

512

264

256

8

8

0

4. 1096 — 1000001001 0

1028

18

16

2

2

-

5. 4096 — 1000001001010

4096

79

64

10

8

2

2

-

6. 12330 — 11000000101010

- 8192
4138
4096
42
32
10
8
2
2

7. 41321 — 1010000101101001

- 32768
8553
8192
361
256
105
64
41
32
9
8
1
1
0

8. 38011 — 1001010001111011

- 32768
5243
4096
1147
1024
123
64
59
32
27
16
11
8
3
2
1
1

9. 30900 |||000|0||0|00

16384

16384
8192
4096
2048
1024
512
256
128
64
32
16
8
4

10. 65535 ||||||||||||||||

1. $16\overline{)214}$ → 13 r 6 → D6

2. 3E7 → $768 + 224 + 7 = 999$

3. $16\overline{)67392}$ → 4208 r 14; $16\overline{)4208}$ → 263 r 0; $16\overline{)263}$ → 16 r 7; $16\overline{)16}$ → 1 r 0 → 1070E

4. $16\overline{)4753}$ → 297 r 1; $16\overline{)297}$ → 18 r 9; $16\overline{)18}$ → 1 r 2 → 1291

5. CCOO $= (3 \cdot 4096) + (13 \cdot 256) + (0 \cdot 16) + (0 \cdot 1) = 3328$

6. $16\overline{)503}$ → 31 r 6; $16\overline{)31}$ → 1 r 15 → 1F6

6. $5AA = (5 \cdot 4096) + (5 \cdot 256) + (10 \cdot 16) + (10 \cdot 1) = 21162$

7. $2345 = (2 \cdot 4096) + (3 \cdot 256) + (9 \cdot 16) + (5 \cdot 1) = 9029$

8. $F23ED = (15 \cdot 65536) + (2 \cdot 4096) + (3 \cdot 256) + (14 \cdot 16) + (13 \cdot 1) = 992237$

9.
$$16\overline{)85002} = 5312 \text{ r } 10 \qquad 16\overline{)5312} = 332 \text{ r } 0 \qquad 16\overline{)332} = 20 \text{ r } 12$$

$$80 \qquad 80 \qquad 32$$
$$50 \qquad 51 \qquad 12$$
$$48 \qquad 48$$
$$20 \qquad 32$$
$$16 \qquad 32$$
$$40$$
$$32$$
$$10$$

$20C0A$

80

10. $16\overline{)128} = 8 \text{ r } 0$

11. $29 = (2 \cdot 16) + (9 \cdot 1) = 41$

12.
$$16\overline{)1024} = 64 \text{ r } 12 \qquad 16\overline{)66} = 4 \text{ r } 2$$

$$92 \qquad 64$$
$$104 \qquad 2$$
$$92$$
$$12$$

$42C$

Brandon Buchanan

Computer Tech I

Combined Numbering Systems

A value is given in one number system. Supply the value for the other two systems.

	Decimal	Hexadecimal
1.	214	D6
2.	999	3E7
3.	67342	1070E
4.	4753	1291
5.		CC00
6.	502	1F6
7.	21930	55AA
8.	9029	2345
9.	992257	F23ED
10.	85002	14C0A
11.	128	80
12.	41	29
13.	1024	400
14.	4096	1000
15.	4096	1000
16.	1048576	100000

Hex-Binary-Decimal WS 03

Complete the following table:

Name: Brandon Buchanan

Hex	Bin	Decimal
4E	01001110	78
ED	11101101	237
FE	11111110	254
37	110111	55
310	110010000	784
AE3	101011100011	2787
1000	1000000000000	4096
F00	111100000000	3840
1001	1000000000001	4097
37F4		14324
3	11	3
12573		75123
2102E	10000100000001110	135214
5CAE		23726

My Name Here

Computer Tech I

Combined Numbering Systems

A value is given in one number system. Supply the value for the other two systems.

	Decimal	Hexadecimal	Binary
1.	**214**	D6	11010110
2.	999	**3E7**	1111100111
3.	369	171	**101110001**
4.	**4753**	1291	0001001010010001
5.	52224	**CC00**	1100110000000000
6.	15	F	**1111**
7.	21930	**55AA**	0101010110101010
8.	8195	2003	**1000000000011**
9.	992237	**F23ED**	11110010000111101101
10.	**85002**	14E0A	00010100111000001010

Brandon Buchanan

Dr. K. E. Holbert

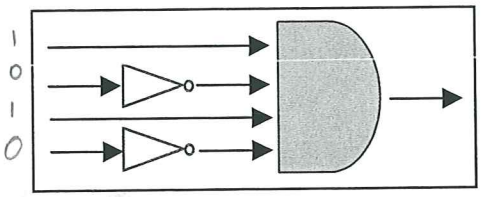
9/7/04

Pick the Locks

Now the user may test his/her understanding of digital logic by tracing how the input values would pass through the digital logic gates to possibly open the lock.
That is, you should be able to deduce the lock combination by looking at each logic diagram. Once deduced, then test your hypothesis by using those input values.
Note: the cell formulas on this sheet may be unhidden after unprotecting the sheet.

Lock #1

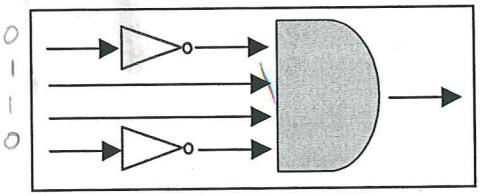
Input A:	1
Input B:	1
Input C:	1
Input D:	1



Output: **0** Locked

Lock #2

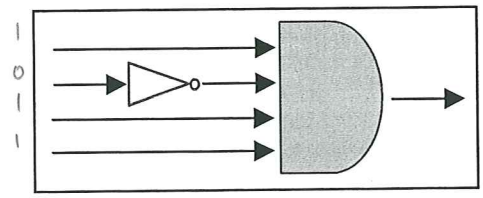
Input A:	1
Input B:	1
Input C:	1
Input D:	1



Output: **0** Locked

Lock #3

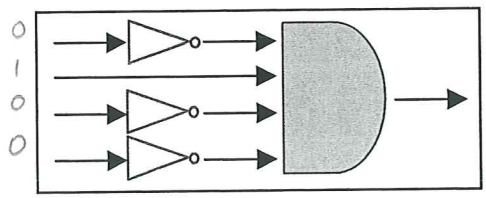
Input A:	1
Input B:	1
Input C:	1
Input D:	1



Output: **0** Locked

Lock #4

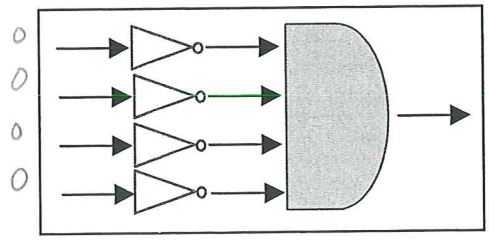
Input A:	1
Input B:	1
Input C:	1
Input D:	1



Output: **0** Locked

Lock #5

Input A:	1
Input B:	1
Input C:	1
Input D:	1



Output: **0** Locked

Question: How many possible combinations are there for a 4-input lock like those above?

Computer Technology

Digital Lock Truth Table Name

Input Combination				Lock Output				
A	B	C	D	Lock #1	Lock #2	Lock #3	Lock #4	Lock #5
0	0	0	0					
0	0	0	1					
0	0	1	0					
0	0	1	1					
0	1	0	0					
0	1	0	1					
0	1	1	0					
0	1	1	1					
1	0	0	0					
1	0	0	1					
1	0	1	0					
1	0	1	1					
1	1	0	0					
1	1	0	1					
1	1	1	0					
1	1	1	1					

and
XOR
OR

Logic Gate Intro HW

Perform the operations indicated:

$\overline{1100_2}$ 0011	$11_2 \oplus 10_2$	$11_2 * 10_2$
1. $1001_2 * 1011_2$	$12_{10} + 6_{10}$	$37_{10} + 42_{10}$
$64_h + 53_h$	$\overline{62_h}$	$\overline{1101_2} * D_h$
$23_{10} * 12_h$	$1010_2 + 0011_2 + 1000_2$	$100011_2 * 43_h$
$43_h * 23_h + 52_h$	$43_h + 23_h * 52_h$	$\overline{11000_2} + 11000_2 * 11111_2$
$172_{10} * 192_{10}$	$CD5_h * 4096_{10}$	$10101011001_2 \oplus 123_h$
$CD5_h \oplus 4096_{10}$	$1011010_2 \oplus 0111111_2$	21. $53_{10} * 53_h + 10110_2 \oplus C6_h$

Workspace. Please label.

21. 00110101 × 01010011 = 00010001 + 00010110 ⊕ 11000110 = 11010000 = 11010001 = $D1_h$

2. $11 \oplus 10 = 01_2$

3. $11 \cdot 10 = 10_2$

4. $1001 \cdot 1011 = 1001$

5. $1100 \cdot 0110 = 0100 = 4$

6. $100101 + 101010 = 101111 = 47_{10}$

7. $01100100 + 01010011 = 01110111 = 77_h$

8. $\overline{0110\ 0010} = 10011101 = 9D_h$

9. $0010 \cdot 1101 = 0000 = 0_h$

10. $10111 \cdot 10010 = 10010_2 = 12_h$

11. $1011 + 1000 = 1011_2$

12. $0100011 \cdot 1000011 = 0011_2 = 3$

13.

* * Boolean Logic

* Logic Gates

- and or xor

* And

-  a = inputs Q = output

- $a \cdot b$ (a and b)

- truth tables

a	b	Q
0	0	0
0	1	0
1	0	0
1	1	1

* Or gate (inclusive)

- 

- $a + b$

a	b	Q
0	0	0
0	1	1
1	0	1
1	1	1

* Xor (exclusive)

a	b	Q
0	0	0
0	1	1
1	0	1
1	1	0

$a \oplus b$

* Inverter

- a —▷○— $\overline{a}$

- $\overline{a}$ is symbol

a	$\overline{a}$
0	1
1	0

* Nor 

- $\overline{a+b}$

a	b	q
0	0	1
0	1	0
1	0	0
1	1	0

* Nand 

a	b	q
0	0	1
0	1	1
1	0	1
1	1	0

- $\overline{a \cdot b}$

* Xnor 

a	b	q
0	0	1
0	1	0
1	0	0
1	1	1

- $\overline{a \oplus b}$

X -

$(A + B) \cdot C$

A	B	C	Q
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

0	0
1	0
2	0
3	1
4	0
5	1
6	0
7	1

1.

* negative OR 

a	b	0
0	0	0
0	1	1
1	0	0
1	1	0

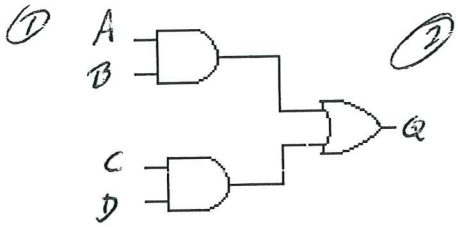
*  $Q = 1$

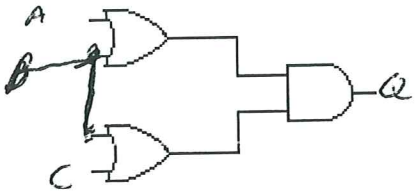
NAME: Brandon Buchanan

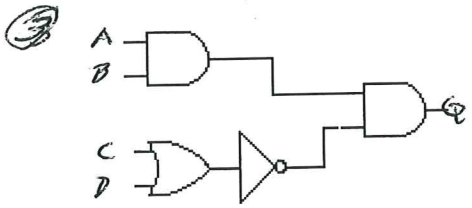
9.10.09

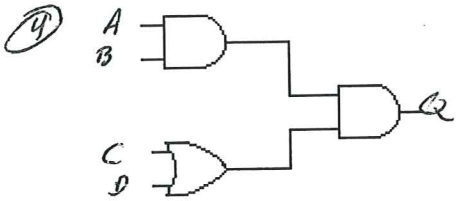
Comp Tech Simple Combo TT

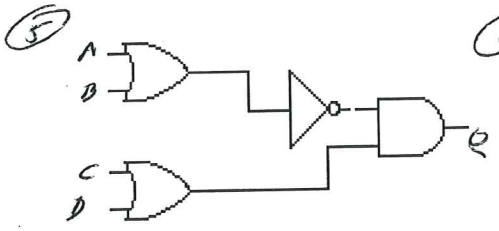
For each of the following,complete a truth table

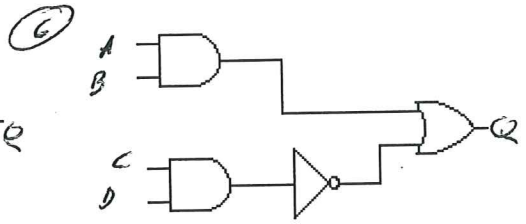
1. 

2. 

3. 

4. 

5. 

6. 

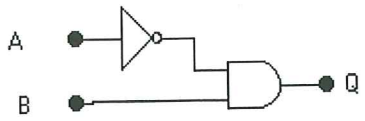
1.	A	B	C	D	Q

5.

A	B	C	D	Q
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

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

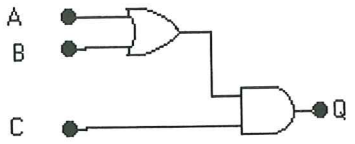
Comp Arch **Boolean Exp** **Name** Brandon Buchanan **8/02**



Boolean Exp $\bar{A} \cdot B$

Truth Table

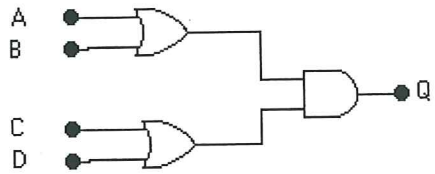
A	B	Q
0	0	0
0	1	1
1	0	0
1	1	0



Boolean Exp $(A+B) \cdot C$

Truth Table

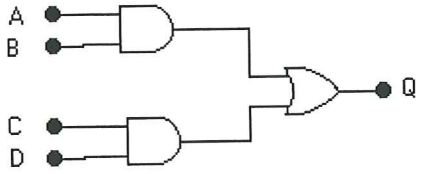
A	B	C	Q
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1



Boolean Exp $(A+B) \cdot (C+D)$

Truth Table

A	B	C	D	Q
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

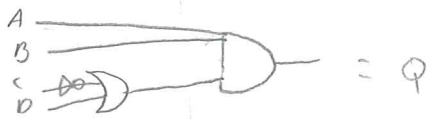


Boolean Exp $(A \cdot B) + (C \cdot D)$

Truth Table

A	B	C	D	Q
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

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



$\overline{ABC}$

Computer Arch **Name** Brandon Buchanan 9.3.04 **8/02**

93

Show all work in space provided- no work, no credit

1) 1101_b = 13 h

8 4 1

9+4+1

-½

2) 101101_b = 45 10

32 8 4 1

3) 124_{10} = 0111 1100 b

16 | 124 = 7 r12

112

r12

07 12_h =

0111 1100_b

4) $2E4_h$ = 0010 1110 0100 b

0010 1110 0100

2 E 4

5) 135_{10} = 87 h

1 0 0 0 0 1 1 1

128 + 64 + 32 + 16 + 4 + 2 + 1 = 135

1000 0111

8 7

6) EF_h = 239 10

15 · 1 = 15

14 · 16 = + 224

239

7) 1110_1100_b = EC h

E C

8) 254_h = 596 10

10 0101 0100

512 64 16 4

512

+64 > 576

16

+4 > 20

596

9) 1259_{10} = 100 1110 1001 b

16 | 1259 = 78 r11

112

139

128

11

16 | 78 = 4 r14

64

14

4 14 11 $_h$

0100 1110 1001

1011

-½

10) 65537_{10} = 1000 $_h$

4096 r1
16 | 65537
64
153
144
97
96
1

256 r0
16 | 4096
32
89
80
96
96

16 r0
16 | 256
16
96
96

1 r0
16 | 16
16

1000 $_h$

11) $45A2_h$ = 17826 $_{10}$

2 · 1 =
10 · 16 =
5 · 256 =
4 · 4096 =

2 > 162
160
1280
16384 > 17664
17826

23
256
5
1280

32
4096
4
16384

12) 9000_{10} = 0010 0011 0010 1000 $_b$

562 r8
16 | 9000
80
100
96
40
32
8

35 r2
16 | 562
48
82
80
2

2 r3
16 | 35
32
3

2 3 2 8 $_h$
0010 0011 0010 1000

13) 333_h = 0011 0011 0011 $_b$

0011 0011 0011
3 3 3 $_h$

14) 1100110011001100_b = 3276 $_{10}$

CCC $_h$

12 · 1 =
12 · 16 =
12 · 256 =

12
192
204
+3072
3276

12
256
12
512
2560
3072

15) 8192_{10} = 10 0000 0000 0000 $_b$

512 r0
16 | 8192
80
19
16
32
32

32 r0
16 | 512
48
32
32
-

2 r0
16 | 32
32
-

2 0 0 0
10 0000 0000 0000

16) 145237_{10} = 23755 $_h$

9077 r5
16 | 145237
144
123
112
117
112
5

567 r5
16 | 9077
80
107
96
117
112
r5

35 r7
16 | 567
48
87
80
r7

2 r3
16 | 35
32
r3

2 3 7 5 5

17) $45EE3_h$ = 286435 $_{10}$

3 · 1 =
14 · 16 =
14 · 256 =
5 · 4096 =
4 · 65536 =

3
224
3584
20480
262144
286435

2560
+1024
3584

2
65536
×
4
262144

18) 511_{10} = 1 1111 1111 $_b$

31 r15
16 | 511
48
31
16
15

1 r15
16 | 31
16
15

1 E E
1 1110 1110

19) 1048576_{10} = 100000 $_h$

65536 r0
16 | 1048576
96
88
80
85
80
57
48
96
96

4096 r0
16 | 65536
256 r0
16 | 4096
16 r0
16 | 256
1 r0
16 | 16

100000 $_h$

20) 196608_{10} = 0011 0000 0000 0100 0000 $_b$

12288 r0
16 | 196608
16
36
32
46
32
140
128
128
128
0

768 r4
16 | 12288
112
108
96
128
128
0

48 r1
16 | 768
64
128
128
0

3 r0
16 | 48
48
0

3 0 1 4 0
0011 0000 0000 0100 0000

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1. $(A \cdot B) + (C \cdot D)$

A	B	C	D	Q
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

2. $(A + B) \cdot (B + C)$

A	B	C	Q
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

3.

A	B	C	D	Q
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

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

4.

A	B	C	D	Q
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

$(A \cdot B) \cdot (C + D)$

9-20

a $BD + B(D+E) + \bar{D}(D+F)$

$BD + BD + BE + \bar{D}D + \bar{D}F$

$BD + BE + \bar{D}F$

b $\bar{A}\bar{B}C + \overline{(A+B+\bar{C})} + \bar{A}\bar{B}\bar{C}\bar{D}$

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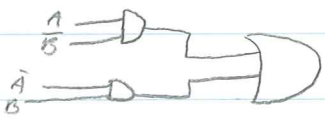
4-17 a



b

PROBLEMS

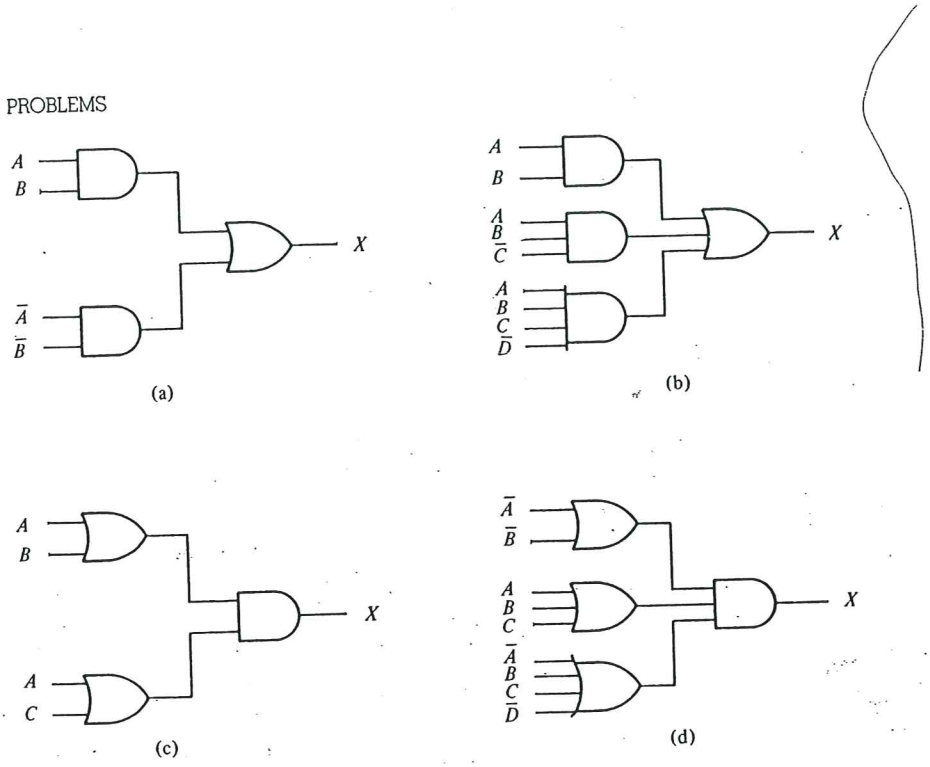


FIGURE 4–34

4–16 Draw the logic circuit represented by each of the following expressions:

(a) $A + B + C$ (b) ABC (c) $AB + C$
(d) $AB + CD$ (e) $\overline{A}B(C + \overline{D})$

4–17 Draw the logic circuit represented by each expression.

(a) $A\overline{B} + \overline{A}B$ (b) $AB + \overline{A}\,\overline{B} + \overline{A}BC$ (c) $A + B[C + D(B + \overline{C})]$

Section 4–6

4–18 Simplify as much as possible the following expressions, using Boolean algebra techniques:

(a) $A(A + B)$ (b) $A(\overline{A} + AB)$ (c) $BC + \overline{B}C$
(d) $A(A + \overline{A}B)$ (e) $A\overline{B}C + \overline{A}BC + \overline{A}\,\overline{B}C$

4–19 Simplify the following expressions, using Boolean algebra:

(a) $(A + \overline{B})(A + C)$ (b) $\overline{A}B + \overline{A}B\overline{C} + \overline{A}BCD + \overline{A}B\overline{C}\,\overline{D}E$
(c) $AB + \overline{A\overline{B}C} + A$ (d) $(A + \overline{A})(AB + AB\overline{C})$
(e) $AB + (\overline{A} + \overline{B})C + AB$

4–20 Simplify each expression, using Boolean algebra:

(a) $BD + B(D + E) + \overline{D}(D + F)$
(b) $\overline{A}\,\overline{B}C + (A + B + \overline{C}) + \overline{A}\,\overline{B}\,\overline{C}D$
(c) $(B + BC)(B + \overline{B}C)(B + D)$
(d) $ABCD + AB(\overline{CD}) + (\overline{AB})CD$
(e) $ABC[AB + \overline{C}(BC + AC)]$

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4-23

a

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}$	1			
C	1	1		

$\bar{A}\bar{B} + \bar{B}C$

b $A\bar{B}C + AC$

	$\bar{A}\bar{C}$	$\bar{A}C$	AC	$A\bar{C}$
$\bar{B}$			1	
B				

$AC + \bar{B}$

c $\bar{A}BC + \bar{A}B\bar{C} + ABC + AB\bar{C}$

$\bar{A}BC + \bar{C} + A\bar{B}C + \bar{C}$

$\bar{A}BC + \bar{C} + ABC$ $BC + A + \bar{C}$

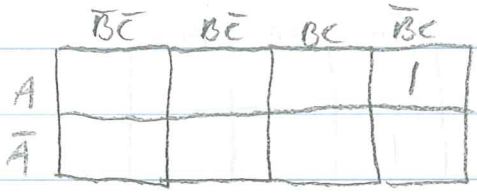
	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}$		1	1	
C		1	1	

B

d $\bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C} + \bar{A}B\bar{C} + AB\bar{C}$

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$\bar{A}B$
$\bar{C}$	1	1	1	1
C				

e $A + \bar{B}C$



4-34

Section 4–7

4–21 What size Karnaugh map (number of cells) is required if the number of variables in an expression is

(a) 2 (b) 3 (c) 4 (d) 5

4–22 Using the Karnaugh map method, simplify the following expressions to their minimum sum-of-products form:

(a) $X = \overline{A}\overline{B} + A\overline{B}$ (b) $X = \overline{A}\overline{B} + \overline{A}B$

(c) $X = A\overline{B} + AB$ (d) $X = \overline{A}\overline{B} + A\overline{B} + AB$

(e) $X = A(\overline{B} + AB)$ (f) $X = \overline{A}\overline{B} + AB$

4–23 Use a Karnaugh map to find the minimum sum-of-products form for each expression.

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

(b) $X = AC(\overline{B} + C)$

(c) $X = \overline{A}(BC + B\overline{C}) + A(BC + B\overline{C})$

(d) $X = \overline{A}\overline{B}\overline{C} + A\overline{B}\overline{C} + \overline{A}B\overline{C} + AB\overline{C}$

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

4–24 Use a Karnaugh map to simplify each function to a minimum sum-of-products form.

(a) $X = \overline{A}\overline{B}\overline{C} + A\overline{B}C + \overline{A}BC + AB\overline{C}$

(b) $X = AC[\overline{B} + A(B + \overline{C})]$

(c) $X = DE\overline{F} + \overline{D}E\overline{F} + \overline{D}\overline{E}\overline{F}$

4–25 Use a Karnaugh map to reduce each expression to a minimum sum-of-products.

(a) $X = A + B\overline{C} + CD$

(b) $X = \overline{A}\overline{B}\overline{C}\overline{D} + \overline{A}\overline{B}\overline{C}D + ABCD + ABC\overline{D}$

(c) $X = \overline{A}B(\overline{C}\overline{D} + \overline{C}D) + AB(\overline{C}\overline{D} + \overline{C}D) + A\overline{B}\overline{C}D$

(d) $X = (\overline{A}\overline{B} + A\overline{B})(CD + C\overline{D})$

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

4–26 Repeat Problem 4–25 for the following expressions:

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

(b) $X = B[(\overline{A}\overline{C}D + \overline{A}CD) + (A\overline{C}D + ACD)]$

(c) $X = \overline{A}B + A\overline{B} + \overline{A}B\overline{C}D + \overline{A}BCD$

9-25 a

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}\bar{D}$			1	1
$\bar{C}D$			1	1
CD	1	1	1	1
$C\bar{D}$		1	1	1

b. $\bar{A}\bar{B}C\bar{D} + \bar{A}BCD + ABC\bar{D} + A\bar{B}C\bar{D}$

$\bar{Q}\bar{D} + \bar{Q}D + QD + Q\bar{D}$

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}\bar{D}$	1			
$\bar{C}D$	1			
CD			1	
$C\bar{D}$			1	

d $(\bar{A}\bar{B} + A\bar{B})(\bar{C}D + C\bar{D})$ $(\bar{B})(C)$ $\bar{B}C$

	$\bar{A}\bar{B}$	$A\bar{B}$	AB	$\bar{A}B$
$\bar{C}\bar{D}$	1	1		
$C\bar{D}$	1	1	1	1
CD	1	1	1	1
$\bar{C}D$	1	1		

$\bar{B} + BC$

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Boolean Laws

1. Commutative Law $A+B = B+A$ $AB=BA$

2. Associative Law $A+(B+C) = (A+B)+C$ $A(BC) = (AB)C$

3. Distributive Law $A(B+C) = AB+AC$

4. Rules
   1. $A+0=A$
   2. $A+1=1$
   3. $A*0=0$
   4. $A*1=A$
   5. $A+A=A$
   6. $A+\overline{A}=1$
   7. $A*A=A$
   8. $A*\overline{A}=0$
   9. $\overline{\overline{A}}=A$
   10. $A+AB=A$
   11. $A+\overline{A}B=A+B$
   12. $(A+B)(A+C)=A+BC$

5. DeMorgans Theorem

   $\overline{AB}=\overline{A}+\overline{B}$

   $\overline{A+B}=\overline{A}\,\overline{B}$

$A \oplus B = \overline{A}B + A\overline{B}$

$\overline{A \oplus B} = \overline{\overline{A}B + A\overline{B}} = \overline{\overline{A}B}\;\overline{A\overline{B}} = (A+\overline{B})(\overline{A}+B) = \overline{A}\,\overline{B} + AB$

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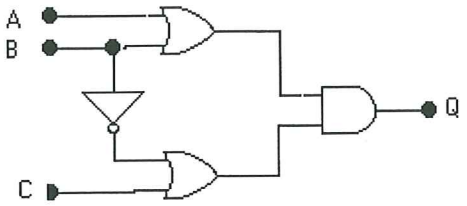
Review for Quiz on logic gates

1) Write the non-minimized Boolean Exp for this circuit. $(A+B)\cdot(\bar{B}+C)$



$(A+B)\cdot(\bar{B}+C)$

2) $1001_2 * 1011_2 =$ 1001_2

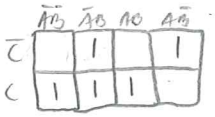
3) Using Boolean Alg, reduce this to minimal form

$Q = AB + \bar{A}\bar{B} + A\bar{B}$

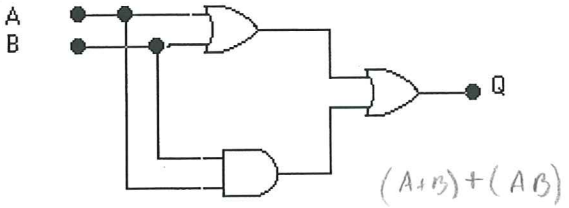
$AB + \bar{A}\bar{B} + A\bar{B}$ $\quad A(B+\bar{B}) + \bar{A}\bar{B}$ $\quad A + \bar{A}\bar{B}$ $\quad A + \bar{B}$

4)Create the minimized circuit that will generate the following truth table.

A	B	C	Q
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

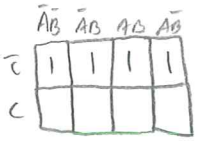


5) Write the truth table for the circuit shown.



$(A+B)+(AB)$

A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1



6) Using Karnaugh mapping, find and Draw minimized circuit.

$Q = \bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C} + \bar{A}B\bar{C} + AB\bar{C} = \bar{C}$

7) $CD5_h \oplus 4096_{10} =$ 1000_h

8) Draw the minimal circuit

$Q = \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + AB\bar{C}$

$\bar{A}\bar{B}(\bar{C}+C)$

$\bar{A}\bar{B} + AB\bar{C}$

$\bar{B}(\bar{A}+AC)$