Name: Omar Ashraf Mabrouk ID: 19P8102 C-2, Sec 3

Sheet 1

1. Octal: 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40

2. HEX: 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 1A, 1B, 1C, 1D, 1E, 1F, 20

2. Base 12: 8, 9, A, B, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 1A, 1B, 20, 21, 22, 23, 24

3. a) 32k Bytes = 32×2^{10} = 32768 bytes
   b) 64 M bytes = 64×2^{20} = 67108864
   c) 6.4 G bytes = 6.4×2^{30} = 6871947674

4. a) $0 \times 5^0 + 1 \times 5^1 + 3 \times 5^2 + 4 \times 5^3$ = 580
   b) $(198)_{12} = 8 \times 1 + 9 \times 12 + 1 \times 12^2$ = 260
   c) $(435)_8 = 5 \times 1 + 3 \times 8 + 4 \times 8^2$ = 285
   d) $(345)_6 = 5 \times 1 + 4 \times 6 + 3 \times 6^2$ = 137
   e) $(AC5)_{16} = 5 \times 1 + 12 \times 16 + 10 \times 16^2$ = 2757
   f) $(1011001)_2 = 1 \times 1 + 1 \times 2^3 + 1 \times 2^4 + 1 \times 2^6$ = 89

5. $2^{16} - 1$ = 65535 (decimal)
   1111 1111 1111 1111 (Binary)
   F F F F (HEX)

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6. a) $\frac{14}{2} = 5$ $\quad$ $(1b+4)/2 = 5$

$1b+4 = 10$ $\quad$ $\boxed{b=6}$

b) $(5b+4)/4 = (1b+3)$

$5b+4 = 4b+12$

$b = 12-4 = 8 \Rightarrow \boxed{b=8}$

c) $(2b+4) + (1b+7) = 4b$

$3b+11 = 4b$ $\quad$ $b = 11$

7. $(1b+1) = 9$

$\boxed{b=8}$

8. $(64CD)_{16} = (0110 \quad 0100 \quad 1100 \quad 1101)_2$

$= (16 \quad 2 \quad 31 \quad 15)_8$

9. $(431)_2$

Binary direct: 431/2 R 1

215/2 R 1

107/2 R 1

53/2 R 1

26/2 R 0

13/2 R 1

6/2 R 0

3/2 R 1

1/2 R 1

$11010111)_2$

hex to Binary: 431/16 R F

26/16 R A

1/16 R 1

$(1AF)_{16}$

Binary: $(0001 \quad 1010 \quad 1111)_2$

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10. a) $(10110.0101)_2 = 2^4 + 2^2 + 2 + 2^{-2} + 2^{-4} = 22.3125$

b) $(16.5)_{16} = 1 \times 16 + 6 \times 1 + 5 \times 16^{-1} = 22.3125$

c) $(26.24)_8 = 2 \times 8 + 6 \times 1 + 2 \times 8^{-1} + 4 \times 8^{-2} = 22.3125$

d) $(DADA.B) = 13 \times 16^3 + 10 \times 16^2 + 13 \times 16 + 10 \times 1 + 11 \times 16^{-1} = 56026.6875$

e) $(1010.1101)_2 = 2^3 + 2^1 + 2^{-1} + 2^{-2} + 2^{-4} = 10.8125$

11. a) $(1.1010)_2 = 1 + 2^{-1} + 2^{-4} = (1.5625)_{10} = (1.9)_{16}$

b) $(110.010)_2 = 2^2 + 2 + 2^{-2} = (6.25)_{10} = (6.4)_{16}$

The answers in (b) is 4 times The answer at (a) because

$(1.1010)_2 \times 2^2 = (110.010)_2$

12. a) $\begin{array}{r} 1011 \\ +\ 0101 \\ \hline 10000 \end{array}$, $\begin{array}{r} 1011 \\ \times\ 0101 \\ \hline 1011 \\ 0000\ \\ 10110\ \\ +\ 00000\ \\ \hline 01101111 \end{array}$

b) $\begin{array}{r} 2E \\ +\ 34 \\ \hline 62 \end{array}$, $\begin{array}{r} 2E \\ \times\ 34 \\ \hline B8 \\ +\ 8A\ \\ \hline 958 \end{array}$

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6.

B- a) 27/16 R B
1/16 R 7

Hex = 7B.5AB7

0.315 x 16 = 5.04 int 5
0.04 x 16 = 0.64 int 0
0.64 x 16 = 10.24 int A
0.24 x 16 = 3.84 int 3
0.84 x 16 = 13.44 int D
0.44 x 16 = 7.04 int 7
0.04 x 16 = 0.64 int 0

=

Binary = (0001 1011 0101 0000 1010 0011 1101 0111)

~~b) 2/3 = 0.6667~~

~~0.67 x 2 = 1.34 int 1~~
~~0.34 x 2 = 0.68 int 0~~
~~0.68 x 2 = 1.36 int 1~~
~~0.36 x 2~~

~~b) 2/3 = 0.6667~~
~~0.6667 x 2 =~~

1110 1110

b) 2/3 x 2 = 1.33 int 1
1/3 x 2 = 2/3 int 0
$(0.10\ 10\ 10\ 10)_2 = 2^{-1} + 2^{-3} + 2^{-5} + 2^{-7} = 0.6640625_{10}$
~~0.0101~~

Error Percentage = $\frac{2/3 - 0.6640625}{2/3} \times 100\% = 0.390625\ \%$

C) $(0.AA)_{16} = 10 \times 16^{-1} + 10 \times 16^{-2} = 0.6640625$, The answer is The Same to Binary but not to 2/3

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		1's Complement	2's Complement
14. a)	0001 0000	→ 1110 1111	→ 1111 0000
b)	0000 0000	→ 1111 1111	→ 0000 0000
c)	1101 1010	→ 0010 0101	→ 0010 0110
d)	1010 1010	→ 0101 0101	→ 0101 0110
e)	1000 0101	→ 0111 1010	→ 0111 1011
f)	1111 1111	→ 0000 0000	→ 0000 0001

Decimal equivalent: a) → 239 → 240

b) → 255 → 0

c) → 37 → 38

d) → 85 → 86

e) → 122 → 123

f) → 0 → 1

15. a) 4637 → 0001 0010 0001 1101

-2579 → 1111 0101 1110 1101 + → 2's Complement

0000 1 0000 0000 1010 → Answer

~~Answer = 1111 0111 1111 0000~~

b) 125 → 0000 0000 0111 1101

-1800 → 1111 1000 1111 1000 → 2's Complement

1111 1001 0111 0101 → 2's Complement

Answer = - 0000 0110 1000 1011 → Answer

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c) 2043 → 0000 0111 1111 1011
-4361 → 1110 1110 1111 0111 + → 2's Complement

1111 0110 1111 0010 → 2's Complement Answer

Answer = -0000 1001 0000 1110 → Answer as Signed Magnitude

d) 7631 → 0000 0110 0101 1111
-745 → 1111 1101 0001 0111 + → 2's Complement

0000 0011 0111 0110 → Answer

16. a) 10011 + 01110 = 00001 → Answer

b) 100010 + 011010 = 111100 → - 000100 → answer

c) 001001 + 001010 = 010011 → -101101 → answer

d) 101000 + 101011 = 010011 → -101101 → answer

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c) Sheet 2

a) 1001 0011 1000 0111
+ 0111 0011 0001 0101

0001 0000 0110 1001 1100
1 0110 +

0001 0000 0110 1010 0010
1 0110

0001 0000 0111 0000 0010 ~~Answer~~
0110

0001 0110 0111 0000 0010 → Answer

b) 0011 1001 1000
0001 1001 1000 +
1 1 1

0101 0011 0000
0110 0110 +

0101 ~~0011~~ 0110 → Answer
1001

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c) 0100 0000 1001 1000
0001 1001 0000 1000 +
11

0101 1001 1010 0000
0110 +

0101 1001 1010 0110 ~~Answer~~
1 0110 + 1
11

0101 1010 0000 0110
0110 +
1 11

0110 0000 0000 0110 → Answer

2- 1- Take The Most Significant bit as it is
2- Exclusive-OR The Most Significant bit with The next bit & get The result
3- Take The result and Exclusive-OR with The next bit
4- Repeat 2 & 3

3- 1- Take The Most Significant as it is
2- xOR The most Significant bit with The next bit & get the result
3- xOR This result with The next bit
4- Repeat 2 & 3.

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~~17. 49 → binary~~

17. 49/2 — R 1
24/2 — R 0
12/2 — R 0
6/2 — R 0
3/2 — R 1
1/2 — R 1

49 → binary = 110001
29 → binary = 011101

① 29 + (−49) = 011101 + 001111

101100 → 2's Complement

Answer ①: −010100 = $-1 \times 2^2 + 2^4 = -20$

29/2 — R 1
14/2 — R 0
7/2 — R 1
3/2 — R 1
1/2 — R 1

② (−29) + (+49) = 100011 + 110001

010100

Answer ②: 010100 → $2^2 + 2^4 = +20$

③ (−29) + (−49) = 100 011 + 001 111

011 010 → 2's Complement

Answer ③: −001 110 → $-1 \times (2 + 2^2 + 2^3 + 2^6)$

$= -78$

18. a) 0110 0010 0100 1000
b) 1001 0101 0111 1011
c) 1100 0010 0100 1110
d) 1000 0011 0110 1011

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4- 1- Take Least significant bit multiply it by the other binary
2- Shift the result by N to the right where N is the Position of the bit starting from 0
3- Repeat 1, 2
4- Add the Results.

5. $(0.1)_{10}$

0.1 x 2 = 0.2 int 0
0.2 x 2 = 0.4 int 0
0.4 x 2 = 0.8 int 0
0.8 x 2 = 1.6 int 1
0.6 x 2 = 1.2 int 1
0.2 x 2 = 0.4 int 0
0.4 x 2 = 0.8 int 0
0.8 x 2 = 1.6 int 1

8-bits → 0.00011001

16 bits → 0.0001100110011001

Error percentage = $\frac{0.1 - 0.09765625}{0.1} \times 100 = 2.34375\%$ → 8-bits error

Error Percentage = $\frac{0.1 - 0.0999908447}{0.1} \times 100 = 0.009155\%$ → 16-bit error

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$(a(a'+b))' = a' + (a'+b)' = a' + ab'$

c) $z + z'(v'w + xy) = (z+z')(z + (v'w+xy))$

$= z + v'w + xy \Rightarrow (z + v'w + xy)' = z'(v'w)'(xy)'$

$= z'(v+w')(x'+y')$

10 - a) $F_1 = m_1 + m_2 \qquad F_2 = m_2 + m_3$

$E = F_1 + F_2 = m_1 + m_2 + m_2 + m_3 = m_1 + m_2 + m_3$

Sum of minterms

b)

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8- $f = wx + yz$

$f' = (wx+yz)' = (wx)' \cdot (yz)' = (w+x')(y'+z')$

$= w'y' + w'z' + x'y' + x'z'$

Proof $FF' = 0$, Let $wx+yz = A$

$\therefore FF' = AA'$ $\therefore FF' = 0$

$\therefore F+F' = A+A'$ $\therefore F+F' = A+A' = 1$

9- a) $(xy' + x'y)' = (xy')'(x'y)' = (x'+y)(x+y')$

$x'y' + xx' + x'y + yx' + yy'$

$y(x'+x) = y$

$= x'y' + x'y + yx = x'y' + y = (x'+y)(y+y')$

$= x'+y$

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

$(aa + ab' + ca + cb')(a'+b+c')$

$(a + ab' + ca + cb')(a'+b+c')$

$(a + ca + cb')(a'+b+c') = (a+cb')(a'+b+c')$

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

$aa' + a'cb' + ab + cbb' + c'a + cc'b'$

$a'b'c + ab + c'a$

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

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

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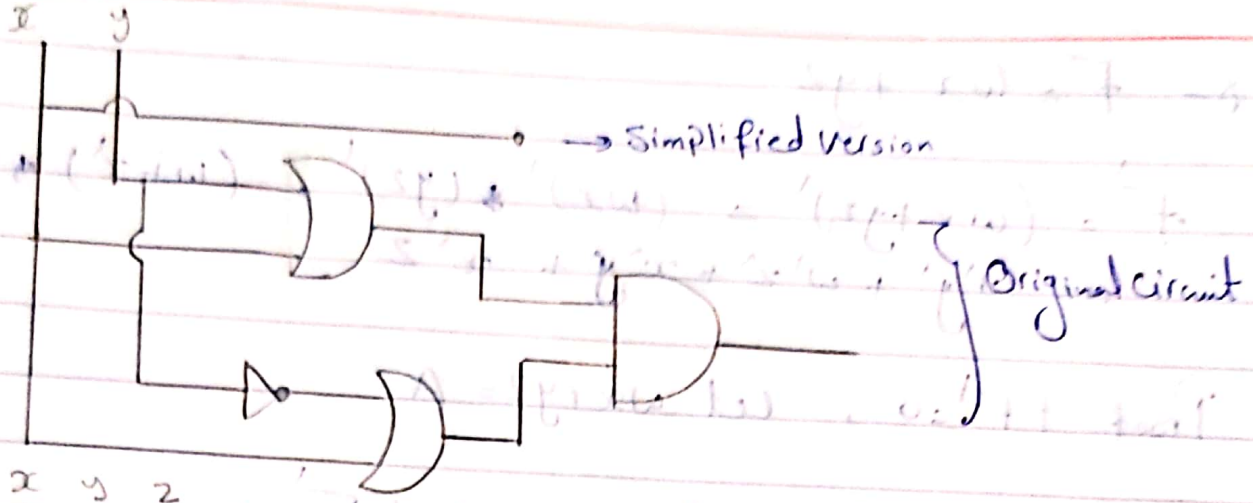
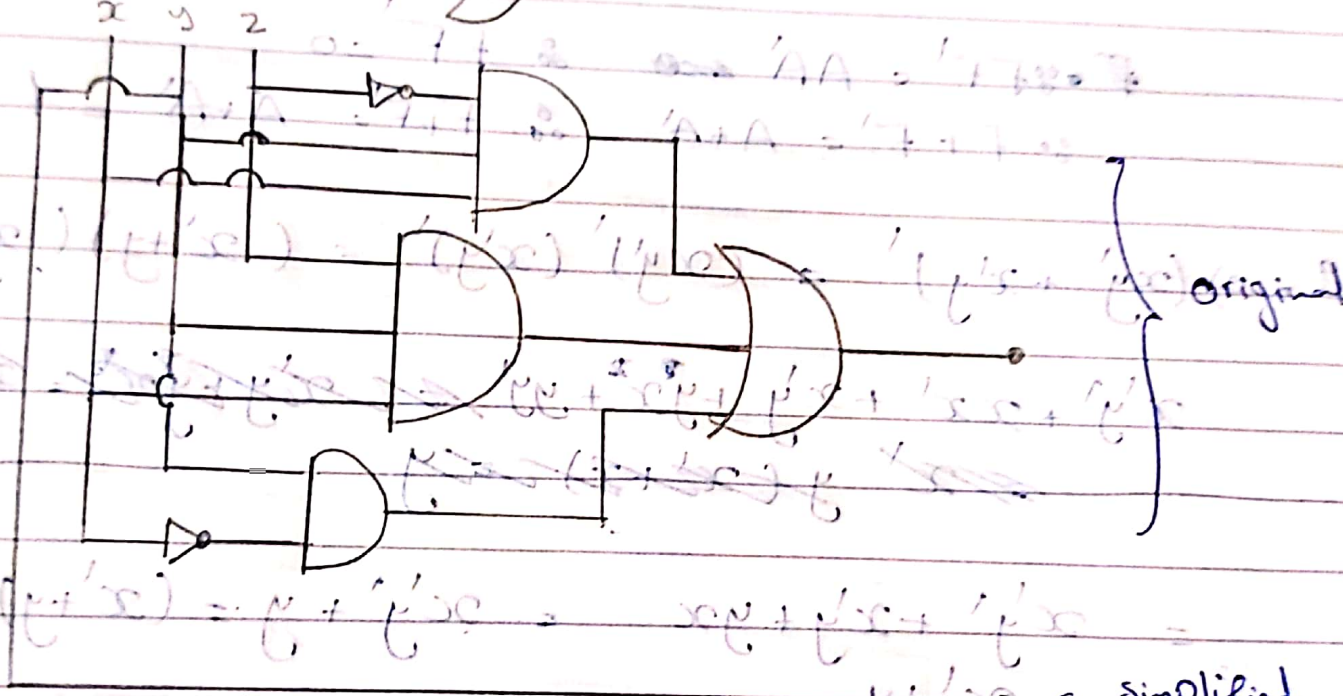
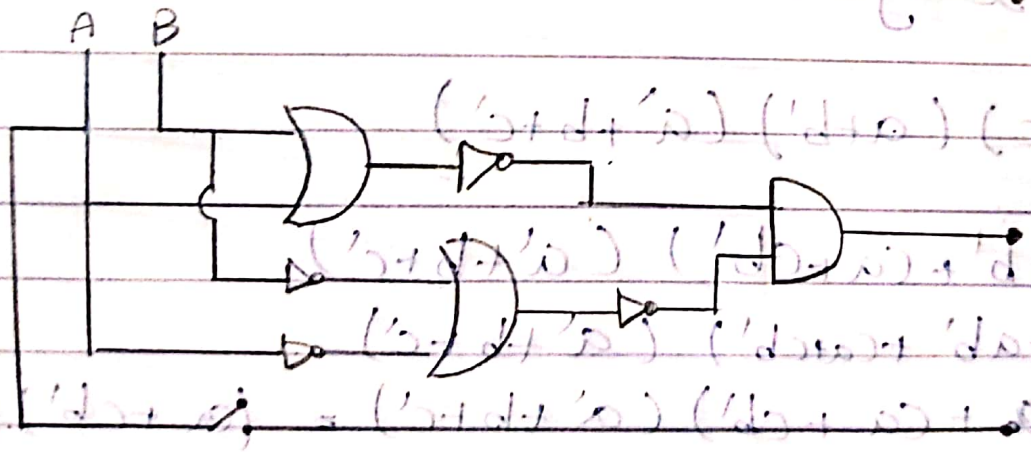
5)



6)



7)



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4-a) $A'C' + ABC + AC' = C'(A+A') + ABC$

$= C' + ABC = (C'+AB)(C'+C)$.

$= C' + AB$ *

b) $(x'y'+z)' + z + xy + wz$ // ~~$xyz' + z + xy + wz$~~.

$(x'y')'z' + z + xy + wz = (x+y)z' + z + xy + wz =$

$z + (x+y)z' + xy = z + xz' + yz' + xy$

$= (z+x)(z+z') + yz' + xy = z + x + yz' + xy$

$= (z+y)(z+z') + x + xy = z + y + x + xy$

$= z + y + x$ *

c) $A'B(D' + C'D) + B(A + A'CD)$

$A'B(D' + C'D) + B(A + CD)$

$A'B(D' + C') + B(A + CD)$

1. $A + D' + C'$

$B(A'(D' + C') + A + CD) = B(A + D' + C' + CD)$

$= B(A + D' + C' + D) = B(A + C + 1)$

$= B$ *

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d- $(A'+C)(A'+C')(A+B+C'D)$

$(A'(A'+C)+C'(A'+C))(A+B+C'D)$

$(A'A'+CA'+C'A'+CC')(A+B+C'D)$

$(A'+CA'+C'A')(A+B+C'D)$

$(A'+A')(A+B+C'D) = A'(A+B+C'D)$

$A'A + A'(B+C'D) = A'(B+C'D)$ ✱

e) $ABC'D + A'BD + ABCD$

$ABD(C'+C) + A'BD = ABD + A'BD = BD(A+A') = BD$ ✱

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①

A-

x	y	z	$(x+y+z)'$	$x'y'z'$
1	1	1	0	0
1	1	0	0	0
1	0	1	0	0
1	0	0	0	0
0	1	1	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	1	1

b-

x	y	z	$x+yz$	$x+y$	$x+z$	$(x+y)(x+z)$
1	1	1	1	1	1	1
1	1	0	1	1	1	1
1	0	1	1	1	1	1
1	0	0	1	1	1	1
0	1	1	1	1	1	1
0	1	0	0	1	0	0
0	0	1	0	0	1	0
0	0	0	0	0	0	0

c-

x	y	z	$x(y+z)$	xy	xz	$xy+xz$
1	1	1	1	1	1	1
1	1	0	1	1	0	1
1	0	1	1	0	1	1
1	0	0	0	0	0	0
0	1	1	0	0	0	0
0	1	0	0	0	0	0
0	0	1	0	0	0	0
0	0	0	0	0	0	0

d-

x	y	z	$x+(y+z)$	$(x+y)+z$
1	1	1	1	1
1	1	0	1	1
1	0	1	1	1
1	0	0	1	1
0	1	1	1	1
0	1	0	1	1
0	0	1	1	1
0	0	0	0	0

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e-

x	y	z	x(yz)	(xy)z
1	1	1	1	1
1	1	0	0	0
1	0	1	0	0
1	0	0	0	0
0	1	1	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	0	0

2- a) $xy + xy' = x(y+y') = x$

B) $(x+y)(x+y)' = x + (yy') = x + 0 = x$

c) $xyz + x'y + xyz' = xy(z+z') + x'y = y(x+x') = y$

d) $(A+B)'(A'+B')' = A'B'AB = 0$

e) $(a+b+c')(a'b'+c) = (a+b)'+c) \cdot ((a+b)'+c)$

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

$= c + (a+b)'$

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

f) $a'bc + abc' + abc + a'bc'$

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

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3- a) $ABC + A'B + ABC' = B(AC + A' + AC')$

$= B(1 + AC + C') + A') = B(A + A') = B$

b) $x'yz + xz = (x'z + xz)(y + xz) = (z(x + x'))(y + xz)$

$= z(y + xz) = zy + xz = z(y + x)$

c) $(x + y)'(x' + y') = x'y'(x' + y') = x'y' + x'y' = x'y'$

$= (x + y)'$

d) $xy + x(wz + wz') = xy + xw(z + z') = xy + xw$

$x(y + w)$

e) $(BC' + A'D)(AB' + CD') = AB'(BC' + A'D) + CD'(BC' + A'D)$

$= AB'BC' + A'DAB' + CC'D'B + CD'DA'$

$= A.0.C' + 0.D.B' + B.D'.B + C.0.A' = 0$

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

$aa' + ac' + b'a' + b'c' + c'a' + c'c' =$

$0 + ac' + b'a' + b'c' + c'a' + c' = c'(a + a') + b'a' +$

$b'c' + c' = c' + b'a' + b'c' + c'$

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

$= c' + b'a' + b'c'$

$= c' + b'a'$

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