4) Perform the following additions

a. $(2267)_8 + (1777)_8$
b. $(2267)_9 + (1777)_9$
c. $(2267)_{16} + (1777)_{16}$

★Solutions

a) $(2\ 2\ 6\ 7)_8 + (1\ 7\ 7\ 7)_8$

$(10\ 14\ 14)$
$(4\ 2\ 6\ 6)_8$

b) $(2\ 2\ 6\ 7)_9 + (1\ 7\ 7\ 7)_9$

$(4\ 10\ 14\ 14)$
$(4\ 1\ 5\ 5)_9$

c) $(2\ 2\ 6\ 7)_{16} + (1\ 7\ 7\ 7)_{16}$

$(3\ 9\ 13\ 14)$
$(3\ 9\ D\ E)_{16}$

5) Perform the following subtractions

a. $(2267)_8 - (1777)_8$
b. $(2267)_9 - (1777)_9$
c. $(2267)_{16} - (1777)_{16}$

★Solutions

a) $(2\ 2\ 6\ 7)_8 - (1\ 7\ 7\ 7)_8$

$(2\ 2\ 6\ 7)_8 + (6\ 6\ 0\ 1)_8$

(X) $(0\ 2\ 7\ 0)_8$

[2]

[b] $(2\ 2\ 6\ 7)_9 - (1\ 7\ 7\ 7)_9$

$(2\ 2\ 6'\ 7)_9 + (7\ 1\ 1\ 2)_9$

$(8\ 11)$

(X) $(0\ 3\ 8\ 2)_9$

[c] $(2\ 2\ 6\ 7)_{16} - (1\ 7\ 7\ 7)_{16}$

$('2\ 2\ 6\ 7)_{16} + (E\ 8\ 8\ 9)_{16}$

$(16\ 15\ 16)$

(X) $(0\ A\ F\ 0)_{16}$

c) $((A+B)\cdot D)' = (A+B)' + D'$

$= A'\cdot B' + D'$

d) $((AB'+C)\cdot D' + E)' = ((AB'+C)\cdot D')'\cdot E'$

$= ((AB'+C)'' + D)\cdot E'$

$= (((AB)'\cdot C' + D)\cdot E'$

$= (A'+B)\cdot C' + D)\cdot E'$

$= A'C'E + BC'E + DE'$

10) Simplify the following Boolean expressions to a minimum number of literals:

a. x.(x+y)
b. x' y z + x z
c. xy + xy'
d. (x + y) (x + y')
e. xyz + x'y + xyz'

* Solutions

[a] $x\cdot(x+y) = x\cdot x + x\cdot y = x + x\cdot y$

$= x\,(1+y) = x\cdot 1 = \boxed{x}$

[b] $x'yz + xz = z\cdot(x'y + x)$

$= z\cdot(x'+x)\cdot(y+x) = z\cdot 1\cdot(y+x)$

$= z\cdot(x+y)$

c) $xy + x\bar{y} = x \cdot (y + \bar{y}) = x \cdot 1 = \boxed{x}$

d) $(x+y)(x+\bar{y}) = x \cdot x + x \cdot \bar{y} + y \cdot x + y \cdot \bar{y}$

$= x + x\bar{y} + xy = x \cdot (1 + \bar{y} + y)$

$= \boxed{x}$

e) $xyz + \bar{x}y + xy\bar{z}$

$= xy(z + \bar{z}) + \bar{x}y$

$= xy + \bar{x}y = (x + \bar{x}) \cdot y$

$= 1 \cdot y = \boxed{y}$

Tutorial 2

1) Determine the value of the base x if, $(410)_x = (226)_8$.

* Solution: $4x^2 + x = 2*8^2 + 2*8 + 6*8^0$

$\Rightarrow 4x^2 + x - 150 = 0 \Rightarrow \boxed{x = 6}$

2) Perform the following addition without converting to decimal
   a. $(110110)_2 + (110101)_2$
   b. $(15F)_{16} + (A7)_{16}$
   c. $(35)_8 + (73)_8$

* Solution

a)
$$\begin{array}{r} 1\ 1\ 0\ 1\ 1\ 0 \\ +\ 1\ 1\ 0\ 1\ 0\ 1 \\ \hline (1\ 0\ 0\ 1\ 0\ 1\ 1)_2 \end{array}$$

b)
$$\begin{array}{r} (1\ 5\ F)_{16} \\ +\ (A\ 7)_{16} \\ \hline 16\ 22 \\ (2\ 0\ 6)_{16} \end{array}$$

c)
$$\begin{array}{r} 1 \\ (3\ 5)_8 \\ +\ (7\ 3)_8 \\ \hline 11\ 8 \\ (13\ 0)_8 \end{array}$$

3) Perform the following multiplication
   a. $(367)_8 * (20)_8$
   b. $(b73)_{16} * (15)_{16}$

* Solution

a)
$$\begin{array}{r} (3\ 6\ 7)_8 \\ *\quad 2\ 0 \\ \hline 0\ 0\ 0 \\ 7\ 5\ 6 \\ \hline (7\ 5\ 6\ 0)_8 \end{array}$$

b)
$$\begin{array}{r} (b\ 7\ 3)_{16} \\ *\quad 1\ 5 \\ \hline F\ 3\ F \\ +\ b\ 7\ 3\ 0 \\ \hline C\ 5\ 6\ F \end{array}$$

1

7) Perform the subtraction of the following unsigned binary numbers using 2's complement

a. 11010-1101
b. 1011-1111
c. 10011 – 10010
d. 100010 – 100110

* Solutions:

a) 11010
- 01101

11010
+ 10011

(1) 01101

b) 1011
- 1111

1011
+ 0001

(-) 1100

-0100

c) 10011
- 10010

10011
+ 01110

(1) 00001

d) 100010
- 100110

100010
+ 011010

(-) 111100

-000100

8) Follow the instructions

a. Find the 16's complement of $(C3DF)_{16}$.
b. Convert C3DF to binary.
c. Find the 2's complement of the result in (b)
d. Convert the answer in (c) to hexadecimal and compare with the answer in (a).

★ Solutions:

[a] C 3 D F

1's Comp: 3 C 2 0

16's Comp: 3 C 2 1 $_{16}$

b) C 3 D F

$(1100\ 0011\ 1101\ 1111)_2$

c) 2's Comp $= (0011\ 1100\ 0010\ 0001)_2$

d) 0011 1100 0010 0001

$(3\ C\ 2\ 1)_{16}$

9) Apply DeMorgan law to the following expressions

a. $A + B'$
b. $X'Y + XZ'$
c. $((A+B).\ D)'$
d. $((A\ B' + C).\ D' + E)'$

★ Solutions:

a) $A+B' = (A' . B)'$

b) $(x'y + xz') = ((x'y)' \cdot (xz')')'$

$= \{(x+y') \cdot (x' + z)\}'$

[5]