SHEET 5

1) $b = 5$ $n = 4$

a) The smallest:

1000 → the smallest 4-digit number with base 5. Because 1 represents the smallest negative number with base 5 while the 0's don't count for anything

In decimal : $1000 \rightarrow -5^3 \cdot 1 = -125$

The largest

0444 → the largest 4-digit number.
If we put 1, 2 and 3 in the first position, the number will become negative because they are integers

In decimal: 0444 → $5^0 \cdot 4 + 5^1 \cdot 4 + 5^2 \cdot 4 = 124$

b) -1 and -8 in b complement notation

-1 → 4444

-8 → 4432

c) Addition:

$$\begin{array}{r} 4444 \\ +\ 4432 \\ \hline 4431 \end{array}$$

We add two negative numbers

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4431 is a negative number too

In order to obtain the value of the number, we find its absolute value going backwards:

- Remove 1:

$$\begin{array}{r} 4431 \\ - \quad 1 \\ \hline 4430 \end{array}$$

- Take its b complement

It is 0014

- Convert it into binary

$$5^0 \cdot 4 + 5^1 \cdot 1 = 4 + 5 = 9$$

$$4430 = -9$$

2) how -273.15_{10} converted into a single precision floating point number

a)

- The number is negative => sign bit = 1

- Distinguish the whole part and the decimal part

whole part = 273

decimal part = 0,15

Whole part => binary

273 mod 2	1
136 mod 2	01
68 mod 2	001
34 mod 2	0001
17 mod 2	10001
8 mod 2	010001
4 mod 2	0010001
2 mod 2	00010001
1 mod 2	100010001
0 mod 2	0100010001

Decimal part => binary

$0,15 \cdot 2 = 0,3$	0
$0,3 \cdot 2 = 0,6$	00
$0,6 \cdot 2 = 1,2$	001
$0,2 \cdot 2 = 0,4$	0010
$0,4 \cdot 2 = 0,8$	00100
$0,8 \cdot 2 = 1,6$	001001
$0,6 \cdot 2 = 1,2$	0010011
$0,2 \cdot 2 = 0,4$	00100110
$0,4 \cdot 2 = 0,8$	001001100
$0,8 \cdot 2 = 1,6$	0010011001

We stop because the digits are repeated

- Normalize the number

$100010001.001001 = 1.00010001001001 \cdot 10^8$

- Add the exponent bias $(127)_{10}$ to the exponent => (8)

127 + 8 = 135

- Convert 135 to binary

135 mod 2	1
67 mod 2	11
33 mod 2	111
16 mod 2	0111
8 mod 2	00111
4 mod 2	000111
2 mod 2	0000111
1 mod 2	10000111
0 mod 2	010000111

- Drop the leading 1 from the representation

Mantissa = (00010001 001001)

It is 14 bits

- Fill the 9 bits that have remained. We fill it with the repeated sequence

00010001001001100110011

b) Combine the results

sign bit = 1
exponent $(10000111)_2$
Mantissa = $(00010001001001100110011)_2$

$-273,15 = 1\ 10000111\ 00010001001001100110011$

3) hexadecimal notation :

f0 9f 90 84

↓

4 bytes

Binary :

1111	000	1001	1111	1001	0000	1000	0100
f	0	9	f	9	0	8	4

Unicode point in binary

000 011111 010000 000100

0001 1111 0100 0000 0100

1 f 4 0 4

u + 1f404

The equivalent character is a cow.