SHEET 5

5.1) $b = 5 \quad n = 4$

a) The smallest

1000 → It is the smallest 4-digit number with base 5. 1 represents the smallest negative number with base 5 and the 0's don't count

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

The largest

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

Decimal : $0444 \rightarrow 5^0 \cdot 4 + 5^1 \cdot 4 + 5^2 \cdot 4 = 124$

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 so 4431 is a negative number too

We find the absolute value of the number going backwards to obtain the value of the number

- Remove 1 → 4431

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

- Take its b complement → 0014

- Convert it into binary

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

4430 = -9

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

As we see the digits are repeated, so we stop

Let's normalize the number

$$100010001.001001 = 1.00010001001001 \cdot 10^{8}$$

Let's add the exponent bias $(127)_{10}$ to the exponent ⇒ (8)

5.2) How is -273.15_{10} converted into a single precision floating point number

a) The number is negative so sign bit = 1

Let's 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

127 + 8 = 135

Let's 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

We drop the leading 1 from the represen-
tation

Mantissa = (00010001001001)

It is 14 bits

We fill the 9 bits that have remained
with the repeated sequence

0001001001001100110011

b) Combine the results

sign bit = 1

exponent = $(10000111)_2$

mantissa = $(00010001001001100110011)_2$

-273,15 = 1 10000111 0001000100100110011001 10011

5.3) 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

The equivalent character is a cow