

Lab 1

Question 1.

1) $88_{10} = 1011000_2$

0	88	2
0	44	2
0	22	2
1	11	2
1	5	2
0	2	2
	1	

2) $444.1875_{10} = 11011100.0011_2$

0	444	2
0	222	2
1	111	2
1	55	2
1	27	2
1	13	2
0	6	2
1	3	2
	1	

$0.1875 \times 2 = 0.375$ 0

$0.375 \times 2 = 0.75$ 0

$0.75 \times 2 = 1.5$ 1

$0.5 \times 2 = 1.0$ 1



$$3) 56_8 = 101110_2$$

each octal digit = 3 binary digits

$$5_8 = 101_2$$

$$6_8 = 110_2$$

$$4) 2E4B_{16} = 0010\ 1110\ 0100\ 1011_2$$

each hex digit = 4 binary digits

$$2_{16} = 0010_2 \quad 4_{16} = 0100_2$$

$$E_{16} = 1110_2 \quad B_{16} = 1011_2$$

$$5) (1000\ 0101)_{BCD} = 101\ 0101_2$$

$$1000 = 8_{10} \quad 0101 = 5_{10} \quad 85_{10}$$

1	85	2
0	42	2
1	21	2
0	10	2
1	5	2
0	2	2
	1	

6) 'Z' ASCII = 01011010₂
8 bits

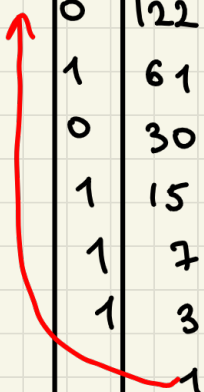
ASCII value of 'Z' = 90₁₀

0	90	2
1	45	2
0	22	2
1	11	2
1	5	2
0	2	2
	1	

1011010 7 bits
adding zero at the front makes it 8 bits

7) 'z' ASCII = 01111010_2

ASCII value of 'z' = 122_{10}




0	122	2
1	61	2
0	30	2
1	15	2
1	7	2
1	3	2

1111010_2 7 bits

01111010_2 8 bits

8) ACK (signal ASCII) = 00000110_2

ACK in ASCII = 6_{10}



0	6	2
1	3	2
	1	

110_2

00000110 8-bit form

Question 2.

1) 101011001001_2

a. $101 \quad 011 \quad 001 \quad 001$

$$101_2 = 5_8 \quad 001_2 = 1_8$$

$$011_2 = 3_8 \quad 001_2 = 1_8$$

$$\text{So } (101011001001)_2 = \underline{5311_8}$$

Hex.

$$1010 \quad 1100 \quad 1001$$

$$1010_2 = A_{16}$$

$$1100_2 = C_{16}$$

$$1001_2 = 9_{16}$$

$$\text{HEX: } \underline{AC9_{16}}$$

b. 11109876543210

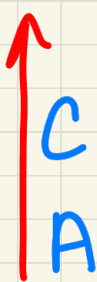
$$\begin{aligned}
 101011001001 &= 1 \cdot 2^{11} + 0 \cdot 2^{10} + \\
 &+ 1 \cdot 2^9 + 0 \cdot 2^8 + 1 \cdot 2^7 + 1 \cdot 2^6 + 0 \cdot 2^5 + 0 \cdot 2^4 + \\
 &+ 1 \cdot 2^3 + 0 \cdot 2^2 + 1 \cdot 2^0 = 2048 + \\
 &+ 512 + 128 + 64 + 8 + 1 = \underline{2761}_{10}
 \end{aligned}$$

Decimal to octal

1	2761	8
1	345	8
3	43	8
5	5	8
	0	

5311₈ matches
1a

Decimal to hex



9	2761	16
12	172	16
10	10	16
	0	

HEX: $AC9_{16}$

matches 19

2) $(AB)_{16}$ in base-2, base-8
base-10

Base-2:

$$A_{16} = 1010_2 \quad B_{16} = 1011_2$$

$$\text{So } \underline{AB_{16} = 10101011_2}$$

Base-8:

010 101 011 group from bin.

$$010_2 = 2_8$$

$$101_2 = 5_8 \quad \text{Octal: } \underline{253_8}$$

$$011_2 = 3_8$$

Base - 10:

$$\begin{aligned} A \times 16^1 + B \times 16^0 &= 10 \times 16 + 11 = \\ &= 160 + 11 = \underline{171_{10}} \end{aligned}$$

3)

a) Magnitude $1_{10} = 001_2$ in 3 bits
positive = 0, negative = 1 - sign bit

-1_{10} has negative so

in 4-bit sign - magnitude

is 1001_2

b) 0000 0001 positive 1 in 8 bits

1111 1110₂ 1's complement

c)

00000000 00000001 positive 1
in 16 bits

+ 11111111 11111110 1's compl.
1

11111111 11111111₂ 2's compl.

2.

(5678)₁₀

9-5=4 9-6=3 9-7=2 9-8=1

$$9's \text{ complement} = 4321$$

$$10's \text{ complement} = 9's + 1$$

$$\begin{array}{r} + 4321 \\ \underline{1} \\ 4322 \end{array}$$

$$\underline{9's \text{ complement: } 4321}$$

$$\underline{10's \text{ complement: } 4322}$$

4)

1. $4CG4_{19}$ to base -10 and 13

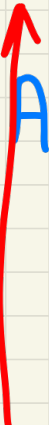
Base -10:

$$\begin{array}{ccccccc} & & & 12 & & 16 & \\ & & & \uparrow & & \uparrow & \\ & 3 & & & 2 & & 1 & \\ 4 \cdot 19^3 & + & C \cdot 19^2 & + & G \cdot 19^1 & + & 4 \cdot 19^0 = \\ = 4 \cdot 6859 & + & 12 \cdot 361 & + & 16 \cdot 19 & + & 4 = \end{array}$$

$$= 27436 + 4332 + 304 + 4 = 32076_{10}$$

$$\underline{4CG4_{19} = 32076_{10}}$$

Base - 13:



5	32076	13
10	2467	13
7	189	13
1	14	13
1	1	13
	0	

$$\underline{4CG4_{19} = 32076_{10} = 117A5_{13}}$$

2.

8-bit 2's complement int.

Most negative: 10000000_2
Most positive: 0111111_2

$$10000000_2 = 127 + 1 = -128_{10}$$

$$0111111_2 = +127_{10}$$

5.

1) Decimal	BCD
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111

8	1000
9	1001
10	0001 0000
11	0001 0001
12	0001 0010
13	0001 0011
14	0001 0100
15	0001 0101

2)

$$\begin{array}{r}
 \text{a) } 1001 \ 0100 \\
 + \quad 0110 \ 0111 \\
 \hline
 1111 \ 1011 \\
 + \quad 0110 \ 0110 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 94 \\
 + 67 \\
 \hline
 161
 \end{array}$$

$$\begin{array}{ccc}
 \underbrace{0001} & \underbrace{0110} & \underbrace{0001} \\
 1 & 6 & 1
 \end{array}$$

Answer: 0001 0110 0001

$$\begin{array}{r} \text{b)} \quad 1001 \quad 1000 \\ + \quad 0001 \quad 0010 \\ \hline \end{array}$$

$$\begin{array}{r} + \quad 1010 \quad 1010 \\ \quad 0110 \quad 0110 \\ \hline \end{array}$$

$$\begin{array}{r} 98 \\ + 12 \\ \hline 110 \end{array}$$

$$\begin{array}{ccc} \underbrace{0001} & \underbrace{0001} & \underbrace{0000} \\ 1 & 1 & 0 \end{array}$$

Answer: 0001 0001 0000