Numeral Systems

Please do the following exercises individually.

Please calculate the values of the following numbers.

1001_{bin}	=	1	·	2^3	+	0	·	2^2	+	0	·	2^1	+	1	·	2^0	=	9_{dec}
0110_{bin}	=		·		+		·		+		·		+		·		=	
1234_{hex}	=		·		+		·		+		·		+		·		=	
$2CD9_{hex}$	=		·		+		·		+		·		+		·		=	
6701_{oct}	=		·		+		·		+		·		+		·		=	

Please calculate the representation of the following numbers.

13	÷	2	=	6	Rem	1	12481	÷		=		Rem		
6	÷	2	=	3	Rem	0		÷		=		Rem		
3	÷	2	=	1	Rem	1		÷		=		Rem		
1	÷	2	=	0	Rem	1		÷		=		Rem		
			=	1101_{bin}						=	_ _ _ _$_{hex}$			
14	÷		=		Rem		1000	÷		=		Rem		
	÷		=		Rem			÷		=		Rem		
	÷		=		Rem			÷		=		Rem		
	÷		=		Rem			÷		=		Rem		
			=	_ _ _ _$_{bin}$						=	_ _ _ _$_{oct}$			

Calculate the number ranges of a given number of digits.

3 hexadecimal digits:	16^3	=	4096	0 …	FFF_{hex}	0 …	4095_{dec}
7 binary digits:		=		0 …		0 …	dec
5 octal digits:		=		0 …		0 …	dec
5 binary digits:		=		0 …		0 …	dec
8 hexadecimal digits:		=		0 …		0 …	dec

Numeral Systems

Please do the following exercises individually.

Please calculate the values of the following numbers.

$1001_{bin} = 1 \cdot 2^3 + 0 \cdot 2^2 + 0 \cdot 2^1 + 1 \cdot 2^0 = 9_{dec}$

$0110_{bin} = 0 \cdot 2^3 + 1 \cdot 2^2 + 1 \cdot 2^1 + 0 \cdot 2^0 = 6_{dec}$

$1234_{hex} = 1 \cdot 16^3 + 2 \cdot 16^2 + 3 \cdot 16^1 + 4 \cdot 16^0 = 4660_{dec}$

$2CD9_{hex} = 2 \cdot 16^3 + 12 \cdot 16^2 + 13 \cdot 16^1 + 9 \cdot 16^0 = 11481_{dec}$

$6701_{oct} = 6 \cdot 8^3 + 7 \cdot 8^2 + 0 \cdot 8^1 + 1 \cdot 8^0 = 3521_{dec}$

Please calculate the representation of the following numbers.

13	÷	2	=	6	Rem	1		12481	÷	16	=	780	Rem	1
6	÷	2	=	3	Rem	0		780	÷	16	=	48	Rem	12
3	÷	2	=	1	Rem	1		48	÷	16	=	3	Rem	0
1	÷	2	=	0	Rem	1		3	÷	16	=	0	Rem	3
			=	1101_{bin}							=	$30C1_{hex}$		

14	÷	2	=	7	Rem	0		1000	÷	8	=	125	Rem	0
7	÷	2	=	3	Rem	1		125	÷	8	=	15	Rem	5
3	÷	2	=	1	Rem	1		15	÷	8	=	1	Rem	7
1	÷	2	=	0	Rem	1		1	÷	8	=	0	Rem	1
			=	1110_{bin}							=	1750_{oct}		

Calculate the number ranges of a given number of digits.

3 hexadecimal digits:	16^3	=	4096	0 … FFF_{hex}	0 …	4095_{dec}
7 binary digits:	2^7	=	128	0 … 1111111_{bin}	0 …	127_{dec}
5 octal digits:	8^5	=	32768	0 … 77777_{oct}	0 …	32767_{dec}
5 binary digits:	2^5	=	32	0 … 11111_{bin}	0 …	31_{dec}
8 hexadecimal digits:	16^8	=	ca. 4 Mrd	0 … $FFFFFFFF_{hex}$	0 …	ca. 4 Mrd_{dec}

Binary System

Please do the following exercises individually.

What is the value of a bit at the following position[1]?

8th bit: $2^7 = 128$

1st bit:

6th bit:

26th bit:

How many bits do you need to get the following number ranges?

14 … 19: contains 6 numbers → 3 bits needed (provides 8 numbers)

1 … 16:

21 … 32:

… 128:

Please fill in the missing entries of the table.

KByte	MByte	GByte	TByte
20,971,520	20,480	20	0.020
	1,024		
			0.05
2,000,000			
		200	
	512		

[1] Counting of bits starts with 1; counting of bit positions with 0. We start counting right most.

Binary System

Please do the following exercises individually.

What is the value of the following bits[1]?

8th bit: $2^7 = 128$

1st bit: $2^0 = 1$

6th bit: $2^5 = 32$

26th bit: $2^{25} = 33554432$

How many bits do you need to get the following number ranges?

14 … 19: contains 6 numbers → 3 bits needed (provides 8 numbers)

1 … 16: contains 16 numbers → 4 bits needed (provides 16 numbers)

21 … 32: contains 12 numbers → 4 bits needed (provides 16 numbers)

0… 128: contains 129 numbers → 8 bits needed (provides 256 numbers)

Please fill in the missing entries of the table.

KByte	MByte	GByte	TByte
20,971,520	20,480	20	0.020
1,048,576	1,024	1	0.00098
53,687,091	52,428	51.2	0.05
2,000,000	1953	1.90735	0.00186
209,715,200	204,800	200	0,19531
524,288	512	0.5	0,00049

[1] Counting of bits starts with 1; counting of bit positions with 0. We start counting right most.

Binary Addition

Please solve the following exercises individually.

Please add the following binary numbers.

1st Summand	1	0	1	1	0	1	1	0
2nd Summand			1	1	0	1	0	1
Carry								
Result								

1st Summand	1	0	1	0	1	1	1	1
2nd Summand			1	1	1	0	0	1
Carry								
Result								

1st Summand	1	0	1	0	1	0	1	0
2nd Summand		1	0	1	0	1	0	1
Carry								
Result								

1st Summand		1	1	1	1	1	1	1
2nd Summand								1
Carry								
Result								

Add the following binary numbers with the Windows calculator.

$2F_{hex} + 83_{hex}$ =

$3FB7_{hex} + 7007_{hex}$ =

$F3_{hex} + 6A_{hex}$ =

$A383_{hex} + 796A_{hex}$ =

Binary Addition

Please solve the following exercises individually.

Please add the following binary numbers.

1st Summand	1	0	1	1	0	1	1	0
2nd Summand	0	0	1	1	0	1	0	1
Carry	0	1	1	0	1	0	0	0
Result	1	1	1	0	1	0	1	1

1st Summand	1	0	1	0	1	1	1	1
2nd Summand	0	0	1	1	1	0	0	1
Carry	0	1	1	1	1	1	1	0
Result	1	1	1	0	1	0	0	0

1st Summand	1	0	1	0	1	0	1	0
2nd Summand	0	1	0	1	0	1	0	1
Carry	0	0	0	0	0	0	0	0
Result	1	1	1	1	1	1	1	1

1st Summand	0	1	1	1	1	1	1	1
2nd Summand	0	0	0	0	0	0	0	1
Carry	1	1	1	1	1	1	1	0
Result	1	0	0	0	0	0	0	0

Add the following binary numbers with the Windows calculator.

$2F_{hex} + 83_{hex} = B2_{hex}$

$3FB7_{hex} + 7007_{hex} = AFBE_{hex}$

$F3_{hex} + 6A_{hex} = 15D_{hex}$

$A383_{hex} + 796A_{hex} = 11CED_{hex}$

Negative Binary Numbers

Please do the following exercises individually.

Please map signed numbers to their unsigned partners.

Range: 0 … 15	Negative: -2	Positive: 14 (15=-1, 14=-2)
Range: 0 … 31	Negative: -3	Positive: _____
Range: 0 … 127	Negative: -5	Positive: _____
Range: 0 … 65535	Negative: -16	Positive: _____

Please determine the negative of the following binary numbers.

Number	0	1	0	1	0	1	0	1
Inverted	1	0	1	0	1	0	1	0
+1	0	0	0	0	0	0	0	1
Carry	0	0	0	0	0	0	0	0
Negative	1	0	1	0	1	0	1	1

Number	1	1	1	1	0	1	0	1
Inverted								
+1								
Carry								
Negative								

Number	1	0	1	0	1	1	1	1
Inverted								
+1								
Carry								
Negative								

Number		1	1	1	1	1	1	1
Inverted								
+1								
Carry								
Negative								

Please mark the negative ones of the following numbers.

What is the rule to figure it out in your head?

$2F_{hex}$ 83_{hex} $F3_{hex}$ $6A_{hex}$ $B7_{hex}$ 07_{hex}

Rule: _____

Please determine the negative of the following binary numbers.

You may use the Windows Calculator.

$2F_{hex}$: $002F_{hex}$:

$6A_{hex}$: $006A_{hex}$:

Negative Binary Numbers

Please do the following exercises individually.

Please map signed numbers to their unsigned partners.

Range: 0 … 15	Negative: -2	Positive: 14 (15=-1, 14=-2)
Range: 0 … 31	Negative: -3	Positive: 29 (31=-1, 30=-2)
Range: 0 … 127	Negative: -5	Positive: 123
Range: 0 … 65535	Negative: -16	Positive: 65520

Please determine the negative of the following binary numbers.

Number	0	1	0	1	0	1	0	1
Inverted	1	0	1	0	1	0	1	0
+1	0	0	0	0	0	0	0	1
Carry	0	0	0	0	0	0	0	0
Negative	1	0	1	0	1	0	1	1

Number	1	1	1	1	0	1	0	1
Inverted	0	0	0	0	1	0	1	0
+1	0	0	0	0	0	0	0	1
Carry	0	0	0	0	0	0	0	0
Negative	0	0	0	0	1	0	1	1

Number	1	0	1	0	1	1	1	1
Inverted	0	1	0	1	0	0	0	0
+1	0	0	0	0	0	0	0	1
Carry	0	0	0	0	0	0	0	0
Negative	0	1	0	1	0	0	0	1

Number	0	1	1	1	1	1	1	1
Inverted	1	0	0	0	0	0	0	0
+1	0	0	0	0	0	0	0	1
Carry	0	0	0	0	0	0	0	0
Negative	1	0	0	0	0	0	0	1

Please mark the negative ones of the following numbers.

What is the rule to figure it out in your head?

$2F_{hex}$ $\underline{\underline{83}}_{hex}$ $\underline{F3}_{hex}$ $6A_{hex}$ $\underline{\underline{B7}}_{hex}$ 07_{hex}

Rule: The MSB must be set. The MSB is set in 8, 9, A, B, C, D, E and F. These are all numbers above 7.

Please determine the negative of the following binary numbers.

You may use the Windows Calculator.

$2F_{hex}$: $11010001_{bin} = D1_{hex}$

$6A_{hex}$: $10010110_{bin} = 96_{hex}$

$002F_{hex}$: $1111111111010001_{bin} = FFD1_{hex}$

$006A_{hex}$: $1111111110010110_{bin} = FF96_{hex}$