1) Complete the following table.

	Decimal (Base 10)	Binary (Base 2)	Hexadecimal (Base 16)
Number of digits:	10	2	16
Digits:	0, 1, 2, 3, 4, 5, 6, 7, 8, 9	0, 1	0, 1, 2, .. 9, A, B, C, D, E, F
Counting:	0000	00000	0
	01	1	1
	2	10	2
	3	00011	3
	4	0100	4
	5	0101	5
	6	0110	6
	7	0111	7
	8	1000	8
	09	1001	9
	10	1010	A
	11	1011	B
	12	1100	C
	13	1101	D
	14	1110	E
	15	01111	00F
	16	10000	10
	17	10001	11

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3. Convert 375_{10} to a binary (base 2) value. 512 256 128 64 32 16 8 4 2 1

375 − 256 = 119; 119 − 64 = 55; 23

0001 0111 0111₂

4. Convert 375_{10} to a hexadecimal (base 16) value.

1 7 7₁₆

5. Convert $2BA_{16}$ to a decimal (base 10) value.

0010 1011 1010₂

512 256 128 64 32 16 8 4 2 1

512 + 128 = 640; 688; 698₁₀

6. Perform the following arithmetic operations:

$1001010_2 + 1101110_2 = 10111000_2$

$1X000X0_2 - 1001011_2 = 0010111_2$

$0CB31A_{16} + 073A18_{16} = 13ED32_{16}$

$AE9D1_{16} - 4A73_{16} = 9CF5E_{16}$

Options for representing signed integers: 8-bit example for ~~-17_{10}~~ -19_{10}

a) signed magnitude:

sign bit	magnitude
1	0 0 1 0 0 1 1

positive is 0
negative is 1

16 8 4 2 1

b) one's complement: positive values are their binary #. For negative values, invert all the bits of binary # of the absolute value

abs(-17) = +17 = 0 0 0 1 0 0 1 1 (-19, +19)
~~-17~~ -19 = 1 1 1 0 1 1 0 0
Invert bits to get one's complement

c) two's complement: positive values are their binary #. For negative values, invert all the bits of binary # of the absolute value, then add 1

abs(-19) = +19 = 0 0 0 1 0 0 1 1
1 1 1 0 1 1 0 0 — Invert bits to get one's complement, then
\+ 1 — Add 1 to get two's complement

-19 = 1 1 1 0 1 1 0 1
0 0 0 1 0 0 1 0
\+1

7. Represent the following decimal numbers in binary using **8-bit** signed magnitude, one's complement, and two's complement:

decimal number	signed magnitude 8-bits	one's complement 8-bits	two's complement 8-bits
97_{10}	(sign bit 64 32 16 8 4 2 1) 0 1 1 0 0 0 0 1	same →	same →
-45_{10} (32, 13)	1 0 1 0 1 1 0 1	+45 0 0 1 0 1 1 0 1 ↓ 1 1 0 1 0 0 1 0 +1	1 1 0 1 0 0 1 1

8. Using 8-bits what is the range of values for each of the following representations:

a) unsigned integers:

00000000_2 to $1111\ 1111$ (2^8)

0_{10} to $2^8 - 1 = 255_{10}$

b) signed integers using two's complement:

1000 0000 → flip bits
0111 1111
\+1
1000 0000 = +128

-128_{10} to 127_{10}

2^7: 0111 1111 = $2^7 - 1$ = 127_{10}