M260 1.5

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Positional Number Systems

7,346.2 written as powers of ten is

7,346.2 = ___·10 + ___·10 +___·10 +___·10 +___·10

Forty-five written as powers of two is

45 = ___·2 + ___·2 +___·2 +___·2 +___·2 +___·2

In binary notation 45_{10} would be written as ______________________. A binary digit is called a __________.

The binary notation for the integers zero through nine is

decimal	**binary**
0_{10}	
1_{10}	
2_{10}	
3_{10}	
4_{10}	
5_{10}	
6_{10}	
7_{10}	
8_{10}	
9_{10}	

Some of the powers of two used for position values in binary notation are

power of 2	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
decimal form											

One way to convert numbers from binary notation to decimal notation is to add the appropriate powers of two. Convert 101110_2 to decimal by adding the appropriate powers of two

________ + ________ + ________ + ________ = _______________

To convert from decimal to binary we start by finding the ____________ power of two that is less than or equal to our number. That determines the ____________ one bit. To get the remaining part we subtract that power of two from our number and repeat the process with the remainder to find the next one bit, etcetera. For example to convert 141_{10} to binary we note that the largest power of two that is less than 141_{10} is _____________. So the leading one bit is in the 2 position. The remaining part is then 141_{10} - _______ = ________. The highest power of two that is less than or equal to __________ is __________. So the next one bit is in the 2 position. Then __________ - _________ = _________ whose binary representation is ___________.
So 141_{10} in binary is _____________.

When adding two numbers in binary notation each column will have zero, one, two, or three ones. These result in zero with no carry, one with ____________, ____________ with _____________, or ____________ with ___________, respectively.

Add the binary numbers and show all the carries

carry row

0 1 0 1 0 1 1

0 1 0 1 1 1 1

__________ result

Subtract the numbers in binary notation (show the borrowing)

borrow row

0 1 1 0 0 0

- 1 0 1 1

____

The two's complement of c in n-bit arithmetic is the binary representation of _________.

To form the two's complement of a binary number simply _____________ and then add _________.

In 8-bit unsigned arithmetic the range of integers represented is _________ to ________.

In 8-bit two's complement arithmetic the range of integers represented is _________ to ________.

Write the numbers 27 and -13 in 8-bit two's complement form and then add them:

27_{10} = __________________

-13_{10} = ___________________

sum = ___________________ = $\_\_\_\_\_\_\__{10}$

Decimal—Hexadecimal—Binary equivalents

decimal	hexadecimal	binary
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

To convert from hexadecimal to decimal add the weighted position values:

$2\ C\ 3_{16} = \underline{\hspace{2em}} \cdot 16^2 + \underline{\hspace{2em}} \cdot 16^1 + \underline{\hspace{2em}} \cdot 16^0$

$= \underline{\hspace{8em}}_{10}$

To convert from hexadecimal to binary notation convert each digit individually using its four bit representation:

$3\ \ D\ \ C\ \ 4_{16}$

$= \underline{\hspace{3em}}\ \underline{\hspace{3em}}\ \underline{\hspace{3em}}\ \underline{\hspace{3em}}_2$

To convert from binary to hexadecimal mark off every ______ bits starting from the right then convert each ______ bits to the corresponding hexadecimal digit:

$0010\ \ 1101\ \ 1100\ \ 0101_2$

$\underline{\hspace{2em}}\ \underline{\hspace{2em}}\ \underline{\hspace{2em}}\ \underline{\hspace{2em}}_{16}$