# Number Systems – Conversion & Math Practice Problems

## Conversion Problems

1. Convert each of the following binary numbers to octal, decimal, and hexadecimal formats.

   $(111011101)_2$

   $(10101010111)_2$

   $(111100000)_2$

2. Convert each of the following octal numbers to binary, decimal, and hexadecimal formats.

   $(3754)_8$

   $(7777)_8$

   $(247)_8$

3. Convert each of the following decimal numbers to binary, octal, and hexadecimal formats.

   $(3479)_{10}$

   $(642)_{10}$

   $(555)_{10}$

4. Convert each of the following hexadecimal numbers to binary, octal, and decimal formats.

   $(4FB2)_{16}$

   $(88BAE)_{16}$

   $(DC4)_{16}$

## Math Problems

1. Perform each of the addition operations indicated below.

   $(1001011)_2 + (11101)_2$

   $(4556)_8 + (1245)_8$

   $(BCD)_{16} + (A34)_{16}$

2. Form the two's complement of each of the following binary numbers.

   $(111011101110)_2$

   $(111111111000100)_2$

   $(100000000)_2$

   $(1010101010111)_2$

3. Perform each of the subtraction operations indicated below using addition and the two's complement of the subtrahend.

   $(100101)_2 - (11011)_2$

   $(1101011)_2 - (111010)_2$

   $(1110111)_2 - (10110111)_2$

# Number Systems – Conversion & Math Practice Problems

## Conversion Problems

**Solutions**

5. *Convert each of the following binary numbers to octal, decimal, and hexadecimal formats.*

**$(111011101)_2$**

to octal: $111\ 011\ 101 = (735)_8$

to decimal: $=(1x2^8) + (1x2^7) + (1x2^6) + (1x2^4) + (1x2^3) + (1x2^2) + (1x2^0)$
$= 256 + 128 + 64 + 16 + 8 + 4 + 1$
$= (477)_{10}$

to hexadecimal: $0001\ 1101\ 1101 = (1DD)_{16}$

**$(10101010111)_2$**

to octal: $010\ 101\ 010\ 111 = (2527)_8$

to decimal: $=(1x2^{10}) + (1x2^8) + (1x2^6) + (1x2^4) + (1x2^2) + (1x2^1) + (1x2^0)$
$= 1024 + 256 + 64 + 16 + 4 + 2 + 1$
$= (1367)_{10}$

to hexadecimal: $= 0101\ 0101\ 0111\ (557)_{16}$

**$(111100000)_2$**

to octal: $= 111\ 100\ 000\ (740)_8$

to decimal: $=(1x2^8) + (1x2^7) + (1x2^6) + (1x2^5)$
$= 256 + 128 + 64 + 32$
$= (480)_{10}$

to hexadecimal: $= 0001\ 1110\ 0000\ (1E0)_{16}$

6. *Convert each of the following octal numbers to binary, decimal, and hexadecimal formats.*

**$(3754)_8$**

to binary: $= (11\ 111\ 101\ 100)_2$

to decimal: $=(3x8^3) + (7x8^2) + (5x8^1) + (4x8^0)$
$= 1536 + 448 + 40 + 4$
$= (2028)_{10}$

to hexadecimal: $= (0111\ 1110\ 1100)_2 = (7EC)_{16}$

**$(7777)_8$**

to binary: $= (111\ 111\ 111\ 111)_2$

to decimal: $=(7x8^3) + (7x8^2) + (7x8^1) + (7x8^0)$

$= 3584 + 448 + 56 + 7$

$= (4095)_{10}$

to hexadecimal: $= (1111\ 1111\ 1111)_2 = (FFF)_{16}$

**$(247)_8$**

to binary: $= (10\ 100\ 111)_2$

to decimal: $=(2x8^2) + (4x8^1) + (7x8^0)$

$= 128 + 32 + 7$

$= (167)_{10}$

to hexadecimal: $= (1010\ 0111)_2 = (A7)_{16}$

7. *Convert each of the following decimal numbers to binary, octal, and hexadecimal formats.*

**$(3479)_{10}$**

to binary: $= 3479 \div 2 = 1739$ rem = 1

$1739 \div 2 = 869$ rem = 1

$869 \div 2 = 434$ rem = 1

$434 \div 2 = 217$ rem = 0

$217 \div 2 = 108$ rem = 1

$108 \div 2 = 54$ rem = 0

$54 \div 2 = 27$ rem = 0

$27 \div 2 = 13$ rem = 1

$13 \div 2 = 6$ rem = 1

$6 \div 2 = 3$ rem = 0

$3 \div 2 = 1$ rem = 1

$1 \div 2 = 0$ rem = 1

reading bottom to top of remainders = $(110110010111)_2$

to octal: $= 3479 \div 8 = 434$ rem = 7

$434 \div 8 = 54$ rem = 2

$54 \div 8 = 6$ rem = 6

$6 \div 8 = 0$ rem = 6

reading bottom to top of remainders = $(6627)_8$

to hexadecimal: = 3479 ÷ 16 = 217 rem = 7
217 ÷ 16 = 13 rem = 9
13 ÷ 16 = 0 rem = 13 (D)
reading bottom to top of remainders = $(D97)_{16}$

**$(642)_{10}$**

to binary: = 642 ÷ 2 = 321 rem =0
321 ÷ 2 = 160 rem = 1
160 ÷ 2 = 80 rem = 0
80 ÷ 2 = 40 rem = 0
40 ÷ 2 = 20 rem = 0
20 ÷ 2 = 10 rem = 0
10 ÷ 2 = 5 rem = 0
5 ÷ 2 = 2 rem = 1
2 ÷ 2 = 1 rem = 0
1 ÷ 2 = 0 rem = 1
reading bottom to top of remainders = $(1010000010)_2$

to octal: = 642 ÷ 8 = 80 rem = 2
80 ÷ 8 = 10 rem = 0
10 ÷ 8 = 1 rem = 2
1 ÷ 8 = 0 rem = 1
reading bottom to top of remainders = $(1202)_8$

to hexadecimal: = 642 ÷ 16 = 40 rem = 2
40 ÷ 16 = 2 rem = 8
2 ÷ 16 = 0 rem = 2
reading bottom to top of remainders = $(282)_{16}$

**$(555)_{10}$**

to binary: = 555 ÷ 2 = 277 rem = 1
277 ÷ 2 = 138 rem = 1
138 ÷ 2 = 69 rem = 0
69 ÷ 2 = 34 rem = 1
34 ÷ 2 = 17 rem = 0
17 ÷ 2 = 8 rem = 1
8 ÷ 2 = 4 rem = 0
4 ÷ 2 = 2 rem = 0
2 ÷ 2 = 1 rem = 0

$1 \div 2 = 0$ rem = 1

reading bottom to top of remainders = $(1000101011)_2$

to octal: = $555 \div 8 = 69$ rem = 3

$69 \div 8 = 8$ rem = 5

$8 \div 8 = 1$ rem = 0

$1 \div 8 = 0$ rem = 1

reading bottom to top of remainders = $(1053)_8$

to hexadecimal: = $555 \div 16 = 34$ rem = 11 (B)

$34 \div 16 = 2$ rem = 2

$2 \div 16 = 0$ rem = 2

reading bottom to top of remainders = $(22B)_{16}$

8. *Convert each of the following hexadecimal numbers to binary, octal, and decimal formats.*

**$(4FB2)_{16}$**

to binary: $(100\ 1111\ 1011\ 0010)_2$

to octal: $(100\ 1111\ 1011\ 0010)_2 = (47662)_8$

to decimal: $= (4x16^3) + (15x16^2) + (11x16^1) + (2x16^0)$

$= (4x4096) + (15x256) + (11x16) + (2x1)$

$= 16384 + 3840 + 176 + 2$

$= (20402)_{10}$

**$(88BAE)_{16}$**

to binary: $(1000\ 1000\ 1011\ 1010\ 1110)_2$

to octal: $(10\ 001\ 000\ 101\ 110\ 101\ 110)_2 = (2105656)_8$

to decimal: $= (8x16^4) + (8x16^3) + (11x16^2) + (10x16^1) + (14x16^0)$

$= (8x65536) + (8x4096) + (11x256) + (10x16) + (14x1)$

$= 16384 + 3840 + 176 + 14$

$= (560046)_{10}$

**$(DC4)_{16}$**

to binary: $(1101\ 1100\ 0100)_2$

to octal: $(110\ 111\ 000\ 100)_2 = (6704)_8$

to decimal: $= (13x16^2) + (12x16^1) + (4x16^0)$

$= (13x256) + (12x16) + (4x1)$

$= 3328 + 192 + 4$

$= (3524)_{10}$

## Math Problems

4. *Perform each of the addition operations indicated below.*

$(1001011)_2 + (11101)_2$

```
   11111   carry
  1001011
+   11101
---------
  1101000
```

$(4556)_8 + (1245)_8$

```
   111   carry
   4556
+  1245
------
   6023
```

$(BCD)_{16} + (A34)_{16}$

```
   11   carry
   BCD
+  A34
------
  1601
```

5. *Form the two's complement of each of the following binary numbers.*

**$(111011101110)_2$**

technique #1: form one's complement and add 1

```
  000100010001
+             1
-------------
  000100010010
```

technique #2: leave least significant 0's unchanged up to an including first least significant 1 – then complement all remaining bits.

000100010010

**$(11111111000100)_2$**

two's complement is: 00000000111100

**$(100000000)_2$**

twos' complement is: 100000000 (note that it is the same!)

**$(1010101010111)_2$**

two's complement is: 0101010101001

6. *Perform each of the subtraction operations indicated below using addition and the two's complement of the subtrahend.*

**$(100101)_2 - (11011)_2$**

```
 1  1 1    carry
  100101
+ 100101
--------
 1001010  carry out of MSB is ignored
  result is (1010)2 = (10)10
```

**$(1101011)_2 - (111010)_2$**

```
    111    carry
  1101011
+ 1000110
---------
 10110001   carry out of MSB is ignored
  result is (110001)2 = (49)10
```

**$(1110111)_2 - (10110111)_2$**

```
  1111111    carry
  01110111
+ 01001001
----------
  11000000  no carry out of MSB – result is in 2's comp
   and is negative, result is (1000000)2 = (-64)10
```