

## **Solution of examples**

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# **Binary, octal and hexadecimal to decimal conversion**

### 3. Conversion between number systems

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#### SOLUTION

Binary  $\longrightarrow$  Decimal

$$(101)_2 = ( \quad ? \quad )_{10}$$

Binary number	1	0	1
Positional weights	<i>2</i>	<i>1</i>	<i>0</i>

The positional weights for each of the digits are written in italics below each digit. Hence the decimal equivalent number is given as:

$$1 \cdot 2^2 + 0 \cdot 2^1 + 1 \cdot 2^0 = 4 + 0 + 1 = (5)_{10}$$

$$\longrightarrow (101)_2 = ( \quad 5 \quad )_{10}$$

### 3. Conversion between number systems

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#### SOLUTION

Binary  $\longrightarrow$  Decimal

$$(11010)_2 = ( \quad ? \quad )_{10}$$

Binary number	1	1	0	1	0
Positional weights	<i>4</i>	<i>3</i>	<i>2</i>	<i>1</i>	<i>0</i>

The positional weights for each of the digits are written in italics below each digit. Hence the decimal equivalent number is given as:

$$1 \cdot 2^4 + 1 \cdot 2^3 + 0 \cdot 2^2 + 1 \cdot 2^1 + 0 \cdot 2^0 = 16 + 8 + 2 = (26)_{10}$$

$$\longrightarrow (11010)_2 = ( \quad 26 \quad )_{10}$$

### 3. Conversion between number systems

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#### SOLUTION

Binary  $\longrightarrow$  Decimal

$$(1111)_2 = ( \quad ? \quad )_{10}$$

Binary number	1	1	1	1
Positional weights	3	2	<i>1</i>	<i>0</i>

The positional weights for each of the digits are written in italics below each digit. Hence the decimal equivalent number is given as:

$$1 \cdot 2^3 + 1 \cdot 2^2 + 1 \cdot 2^1 + 1 \cdot 2^0 = 8 + 4 + 2 + 1 = (15)_{10}$$

$$\longrightarrow (1111)_2 = ( \quad 15 \quad )_{10}$$

### 3. Conversion between number systems

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#### SOLUTION

Octal  $\longrightarrow$  Decimal

$$(12)_8 = ( \quad ? \quad )_{10}$$

Octal number	1	2
Positional weights	<i>1</i>	<i>0</i>

The positional weights for each of the digits are written in italics below each digit. Hence the decimal equivalent number is given as:

$$1 \cdot 8^1 + 2 \cdot 8^0 = 8 + 2 = (10)_{10}$$

$$\longrightarrow (12)_8 = ( \quad 10 \quad )_{10}$$

### 3. Conversion between number systems

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#### SOLUTION

Octal  $\longrightarrow$  Decimal

$$(107)_8 = ( \quad ? \quad )_{10}$$

Octal number	1	0	7
Positional weights	<i>2</i>	<i>1</i>	<i>0</i>

The positional weights for each of the digits are written in italics below each digit. Hence the decimal equivalent number is given as:

$$1 \cdot 8^2 + 0 \cdot 8^1 + 7 \cdot 8^0 = 64 + 7 = (71)_{10}$$

$$\longrightarrow (107)_8 = ( \quad 71 \quad )_{10}$$

### 3. Conversion between number systems

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#### SOLUTION

Octal  $\longrightarrow$  Decimal

$$(200)_8 = ( \quad ? \quad )_{10}$$

Octal number	2	0	0
Positional weights	2	<i>1</i>	<i>0</i>

The positional weights for each of the digits are written in italics below each digit. Hence the decimal equivalent number is given as:

$$2 \cdot 8^2 + 0 \cdot 8^1 + 0 \cdot 8^0 = 2 \times 64 = (128)_{10}$$

$$\longrightarrow (200)_8 = ( \quad 128 \quad )_{10}$$



### 3. Conversion between number systems

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#### SOLUTION

Hexadecimal  $\longrightarrow$  Decimal

$$(15)_{16} = ( \quad ? \quad )_{10}$$

Hexadecimal number	1	5
Positional weights	<i>1</i>	<i>0</i>

The positional weights for each of the digits are written in italics below each digit. Hence the decimal equivalent number is given as:

$$1 \cdot 16^1 + 5 \cdot 16^0 = 16 + 5 = (21)_{10}$$

$$\longrightarrow (15)_{16} = ( \quad 21 \quad )_{10}$$

### 3. Conversion between number systems

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#### SOLUTION

Hexadecimal  $\longrightarrow$  Decimal

$$(FF)_{16} = ( \quad ? \quad )_{10}$$

Hexadecimal number	F	F
Positional weights	<i>1</i>	<i>0</i>

The positional weights for each of the digits are written in italics below each digit. Hence the decimal equivalent number is given as:

$$15 \cdot 16^1 + 15 \cdot 16^0 = 240 + 15 = (255)_{10}$$

$$\longrightarrow (FF)_{16} = ( 255 )_{10}$$

### 3. Conversion between number systems

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#### SOLUTION

Hexadecimal  $\longrightarrow$  Decimal

$$(2C0)_{16} = ( \quad ? \quad )_{10}$$

Hexadecimal number	2	C	0
Positional weights	2	<i>1</i>	<i>0</i>

The positional weights for each of the digits are written in italics below each digit. Hence the decimal equivalent number is given as:

$$2 \cdot 16^2 + 12 \cdot 16^1 + 0 \cdot 16^0 = 512 + 192 = (704)_{10}$$

$$\longrightarrow (2C0)_{16} = ( 704 )_{10}$$

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# **Decimal to binary conversion**

### 3. Conversion between number systems

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#### SOLUTION

**Decimal → Binary**

$$(24)_{10} = ( \quad )_2$$

$$24 = 16 + 8 = 2^4 + 2^3 = (11000)_2$$

Division	Quotient	Generated remainder
24/2	12	0
12/2	6	0
6/2	3	0
2/2	1	1
1/2	0	1

→  $(24)_{10} = (11000)_2$

### 3. Conversion between number systems

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#### SOLUTION

**Decimal → Binary**

$$(9)_{10} = (\quad)_2$$

$$9 = 8 + 1 = 2^3 + 2^0 = (1001)_2$$

Division	Quotient	Generated remainder
9/2	4	1
4/2	2	0
2/2	1	0
1/2	0	1

→  $(9)_{10} = (1001)_2$

### 3. Conversion between number systems

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#### SOLUTION

**Decimal → Binary**

$$(43)_{10} = ( \quad )_2$$

$$43 = 32 + 8 + 2 + 1 = 2^5 + 2^3 + 2^1 + 2^0 = (101011)_2$$

Division	Quotient	Generated remainder
43/2	21	1
21/2	10	1
10/2	5	0
5/2	2	1
2/2	1	0
1/2	0	1

→  $(43)_{10} = (101011)_2$

### 3. Conversion between number systems

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#### SOLUTION

**Decimal → Binary**

$$(24)_{10} = ( \quad )_2$$

$$24 = 16 + 8 = 2^4 + 2^3 = (11000)_2$$

Division	Quotient	Generated remainder
24/2	12	0
12/2	6	0
6/2	3	0
3/2	1	1
1/2	0	1

→  $(24)_{10} = (11000)_2$



### 3. Conversion between number systems

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#### SOLUTION

**Decimal → Binary**

$$(33)_{10} = ( \quad )_2$$

$$33 = 32 + 1 = 2^5 + 2^0 = (100001)_2$$

Division	Quotient	Generated remainder
33/2	16	1
16/2	8	0
8/2	4	0
4/2	2	0
2/2	1	0
1/2	0	1

→  $(33)_{10} = (100001)_2$

### 3. Conversion between number systems

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#### SOLUTION

**Decimal** → **Binary**

$$(256)_{10} = ( \quad )_2$$

$$256 = 2^8 = (10000000)_2$$

➡  $(256)_{10} = (100000000)_2$

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## **From a Binary to Octal Number and Vice Versa**

### 3. Conversion between number systems

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#### SOLUTION


Binary  $\longleftrightarrow$  Octal

$$(100101)_2 = ( \quad ? \quad )_8$$

1 0 0 | 1 0 1  
A B

$$A=100=2^2=4$$

$$B=101=2^2+2^0=5$$

  $(100101)_2 = (45)_8$


$$(10010110)_2 = ( \quad ? \quad )_8$$

0 1 0 | 0 1 0 | 1 1 0  
A B C

$$A=010=2^1=2$$

$$B=010=2^1=2$$

$$C=110=2^2+2^1=6$$

  $(10010110)_2 = (226)_8$

### 3. Conversion between number systems


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#### SOLUTION

Binary  $\longleftrightarrow$  Octal


$$(45)_8 = ( ? )_2$$

4			5		
1	0	0	1	0	1

  $(45)_8 = (100101)_2$

$$(226)_8 ( ? )_2$$

2			2			6		
0	1	0	0	1	0	1	1	0

  $(226)_8 (10010110)_2$

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# **From a Binary to Hexadecimal Number and Vice Versa**

### 3. Conversion between number systems

#### Binary $\longleftrightarrow$ Hexadecimal

$$(11010011)_2 = ( \quad )_{16}$$

1 1 0 1 | 0 0 1 1  
A B

$$A=1101=2^3 + 2^2 + 2^0 = 13=D$$

$$B=0011=2^1 + 2^0 = 3$$

$\longrightarrow (11010011)_2 = (D3)_{16}$

$$(D3)_{16} = ( ? )_2$$

D				3			
1	1	0	1	0	0	1	1

$\longrightarrow (D3)_{16} = (11010011)_2$

### 3. Conversion between number systems

#### Binary $\longleftrightarrow$ Hexadecimal

$$(1111011011)_2 = ( \quad ? \quad )_{16}$$

$001111011011$   
**A      B      C**

$$A = 0011 = 2^1 + 2^0 = 3$$

$$B = 1101 = 2^3 + 2^2 + 2^0 = 13 = D$$

$$C = 1011 = 2^3 + 2^1 + 2^0 = 11 = B$$

$$\longrightarrow (1111011011)_2 = ( 3DB )_{16}$$

$$( 3DB )_{16} = ( ? )_2$$

3				D				B			
0	0	1	1	1	1	0	1	1	0	1	1

$$\longrightarrow ( 3DB )_{16} = (1111011011)_2$$



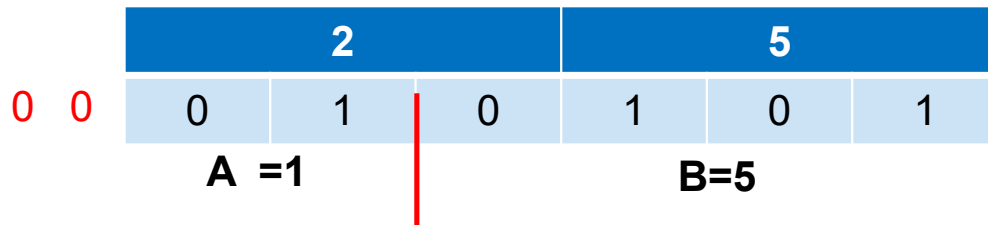
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## **From an Octal to Hexadecimal Number and Vice Versa**

### 3. Conversion between number systems

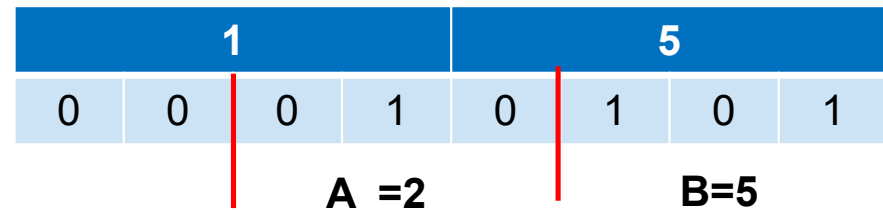
Octal  $\longleftrightarrow$  Hexadecimal

$$(25)_8 = ( \quad )_{16}$$



➔  $(25)_8 = ( 15 )_{16}$

$$(15)_{16} = ( ? )_8$$



➔  $(15)_{16} = ( 25 )_8$

### 3. Conversion between number systems

Octal  $\longleftrightarrow$  Hexadecimal

$$(6401)_8 = ( \quad )_{16}$$

6				4				0				1			
1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1

$\longrightarrow (6401)_8 = (D01)_{16}$

$$(D01)_{16} = ( ? )_8$$

D				0				1			
1	1	0	1	0	0	0	0	0	0	0	1

$\longrightarrow (D01)_{16} = (6401)_8$

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## **From a decimal to an Octal to an Hexadecimal Number and Vice Versa**

### 3. Conversion between number systems

Decimal  $\longleftrightarrow$  Octal  $\longleftrightarrow$  Hexadecimal

$$(68)_{10} = ( \quad ? \quad )_8 = ( \quad ? \quad )_{16}$$

$$68 = 64 + 4 = 2^6 + 2^2 = (1000100)_2$$

$$\begin{array}{ccccccc} 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ | & & | & & | & & | & & \\ \hline \end{array} \longrightarrow (104)_8$$

$$\begin{array}{ccccccc} 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ | & & | & & | & & | & \\ \hline \end{array} \longrightarrow (44)_{16}$$

$$\longrightarrow (68)_{10} = (104)_8 = (44)_{16}$$

$$\begin{array}{c|c|c|c} 68 & 8 & & \\ \hline 4 & 8 & 8 & \\ & 0 & 1 & 8 \\ & & 1 & 0 \end{array} \quad \begin{array}{c|c|c} 68 & 16 & \\ \hline 4 & 4 & 16 \\ & 4 & 0 \end{array}$$

$$\longrightarrow (68)_{10} = (104)_8 = (44)_{16}$$

### 3. Conversion between number systems

Decimal  $\longleftrightarrow$  Octal  $\longleftrightarrow$  Hexadecimal

$$(45)_{10} = ( \quad ? \quad )_8 = ( \quad ? \quad )_{16}$$

$$45 = 32 + 13 = 32 + 8 + 4 + 1 = 2^5 + 2^3 + 2^2 + 2^0 = (101101)_2$$

$$\begin{array}{r|l} 1 & 0 & 1 & 1 & 0 & 1 \\ \hline & & & & & \end{array} \longrightarrow (55)_8$$

$$\begin{array}{r|l} 00 & 1 & 0 & 1 & 1 & 0 & 1 \\ \hline & & & & & & \end{array} \longrightarrow (2D)_{16}$$

$$\longrightarrow (45)_{10} = (55)_8 = (2D)_{16}$$

$$\begin{array}{r|l} 45 & 8 \\ \hline 5 & 5 \\ & 8 \\ & 0 \end{array} \quad (D) \quad \begin{array}{r|l} 45 & 16 \\ \hline 13 & 2 \\ & 16 \\ & 0 \end{array}$$

$$\longrightarrow (45)_{10} = (55)_8 = (2D)_{16}$$