

## **Conversion from Denary to Binary and Hexadecimal**

# Worked Example 1 - Conversion from denary to binary

**Convert 23 in denary to an 8-bit binary number**

2    23    r 1

2    11    r 1

2    5    r 1

2    2    r 0

1

**Reading upwards gives 10111**

**Written in 8-bit binary gives:- 0001 0111**

## Explanation

**23 / 2 gives 11 remainder 1**

**11 / 2 gives 5 remainder 1**

**5 / 2 gives 2 remainder 1**

**2 / 2 gives 1 remainder 0**

## Check Answer

$2^7$     $2^6$     $2^5$     $2^4$     $2^3$     $2^2$     $2^1$     $2^0$

128   64   32   16   8   4   2   1

0   0   0   1   0   1   1   1

**$(1 \times 16) + (1 \times 4) + (1 \times 2) + (1 \times 1)$**

**$= 16 + 4 + 2 + 1$**

**$= 23$**

# Worked Example 2 - Conversion from denary to binary

Convert 46 in denary to an 8-bit binary number

2	46	r 0
2	23	r 1
2	11	r 1
2	5	r 1
2	2	r 0
2	1	

Reading upwards gives 101110

Written in 8-bit binary gives:- 0010 1110

## Explanation

46 / 2 gives 23 remainder 1

23 / 2 gives 11 remainder 1

11 / 2 gives 5 remainder 1

5 / 2 gives 2 remainder 1

2 / 2 gives 1 remainder 0

## Check

$2^7$   $2^6$   $2^5$   $2^4$   $2^3$   $2^2$   $2^1$   $2^0$

128 64 32 16 8 4 2 1

0 0 1 0 1 1 1 0

$(1 \times 32) + (1 \times 8) + (1 \times 4) + (1 \times 2)$

$= 32 + 8 + 4 + 2$

$= 46$

# Worked Example 3 - Conversion from denary to binary

Convert 241 in denary to an 8-bit binary number

2	241	r 1
2	120	r 0
2	60	r 0
2	30	r 0
2	15	r 1
2	7	r 1
2	3	r 1
	1	

Reading upwards gives 1111  
0001

Written in 8-bit binary gives:- 1111 1001

## Explanation

241 / 2 gives 120 remainder 1  
120 / 2 gives 60 remainder 0  
60 / 2 gives 30 remainder 0  
30 / 2 gives 15 remainder 0  
15 / 2 gives 7 remainder 1  
7 / 2 gives 3 remainder 1  
3 / 2 gives 1 remainder 1

## Check

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
1	1	1	1	0	0	0	1

$$\begin{aligned} & (1 \times 128) + (1 \times 64) + (1 \times 32) + (1 \times 16) + (1 \times 1) \\ &= 128 + 64 + 32 + 16 + 1 \\ &= 241 \end{aligned}$$

## Questions to Convert Denary to Binary (Show your working)

- (1) Convert the denary number 156 to binary.
- (2) Convert the denary number 76 to binary.

# Worked Example 4 - Conversion from denary to hexadecimal

Convert 23 in denary to a hexadecimal

16 23 r 7

1

Reading upwards gives 17

23 in denary is 17 in hexadecimal

**Explanation**

**23 / 16 gives 1 remainder 7**

**Check**

$16^1$

$16^0$

16

1

1

7

**$(1*16) + (7*1)$**

**$= 16 + 7$**

**$= 23$**

DENARY 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

HEX 0 1 2 3 4 5 6 7 8 9 A B C D E F 20

# Worked Example 5 - Conversion from denary to hexadecimal

Convert 46 in denary to a hexadecimal

$16 \overline{) 46} \quad r 14 \quad r E$

2

Reading upwards gives 2E

46 in denary is 2E in hexadecimal

DENARY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	20

## Explanation

46 /16 gives 2 remainder 14 (E in hex)

## Check

$16^1$	$16^0$
16	1
2	E

$(2 * 16) + (E * 1)$   
 $= 32 + (14 * 1)$   
 $= 46$

# Worked Example 6 - Conversion from denary to hexadecimal

**Convert 241 in denary to hexadecimal**

16 241 r 1

15  
(F)

## Explanation

**241 / 16 gives 15 (which is F in hex),  
remainder 1**

## Check

$16^1$        $16^0$

16      1

F      1

$$\begin{aligned} & (F * 16) + (1 * 1) \\ &= (15 * 16) + (1 * 1) \end{aligned}$$

$$= 240 + 1$$

$$= 241$$

**Reading upwards gives F1**

**241 in denary is F1 in hexadecimal**

DENARY 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

HEX 0 1 2 3 4 5 6 7 8 9 A B C D E F 20



## Questions and Answers to Convert Denary to Hexadecimal(Show your working)

- (1) Convert the denary number 156 to Hexadecimal.
- (2) Convert the denary number 76 to Hexadecimal.

DENARY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
--------	---	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----

HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	20
-----	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	----

# Questions to Convert Denary to Binary (Show your working)

- (1) Convert the denary number 156 to hexadecimal.

2	156	r 0
2	78	r 0
2	39	r 1
2	19	r 1
2	9	r 1
2	4	r 0
2	2	r 0
	1	

**1001 1100**

## Check

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
1	0	0	1	1	1	0	0

$$\begin{aligned}
 &(1 \times 128) + (1 \times 16) + (1 \times 8) + (1 \times 4) \\
 &= 128 + 16 + 8 + 4 \\
 &= 128 + 28 \\
 &= 156
 \end{aligned}$$

- (2) Convert the denary number 76 to hexadecimal.

2	76	r 0
2	38	r 0
2	19	r 1
2	9	r 1
2	4	r 0
2	2	r 0
	1	

**0100 1100**

## Check

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1
0	1	0	0	1	1	0	0

$$\begin{aligned}
 &(1 \times 64) + (1 \times 8) + (1 \times 4) \\
 &= 64 + 8 + 4 \\
 &= 76
 \end{aligned}$$

# Questions and Answers to Convert Denary to Hexadecimal (Show your working)

DENARY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	20

- (1) Convert the denary number 156 to hexadecimal.

16	156	R 12 (c)	<u><b>9C</b></u>	<u>Check</u>	$(9 \times 16) + (C \times 1)$
					$= (9 \times 16) + (12 \times 1)$
					$= 144 + 12$
					$= 156$

- (2) Convert the denary number 76 to hexadecimal.

16	76	R 12 (c)	<u>Check</u>	$(4 \times 16) + (C \times 1)$
				$= (4 \times 16) + (12 \times 1)$
				$= 64 + 12$
				$= 76$