

EXERCISE NO. 9**-.9.1:-**

Convert the following number from base ten to base two. 64

SOLUTION

2	64	Reminder
2	28	 0
2	16	 0
2	8	 0
2	4	 0
2	2	 0
	1	 0

 $(1000000)_2$ **-.9.2:-**

Convert the following number from base ten to base two. 125

SOLUTION

2	125	Reminder
2	62	 1
2	31	 0
2	15	 1
2	7	 1
2	3	 1
	1	 1

 $(1111101)_2$ **-.9.3:-**

Convert the following number from base ten to base two. 586

SOLUTION

2	586	Reminder
2	293	 0
2	146	 1
2	73	 0
2	36	 1
2	18	 0
2	9	 0
2	4	 1
2	2	 0
	1	 0

 $(1001001010)_2$

-:9.4:-

Convert the following number from base ten to base two.

445

SOLUTION

2	445	Reminder
2	222	 1
2	111	 0
2	55	 1
2	27	 1
2	13	 1
2	6	 1
2	3	 0
	1	 1

 $(110111101)_2$

-:9.6:-

Convert the following number from base ten to base two.

1551

SOLUTION

2	1551	Reminder
2	775	 1
2	387	 1
2	193	 1
2	96	 1
2	48	 0
2	24	 0
2	12	 0
2	6	 0
2	3	 0
	1	 1

 $(11000001111)_2$

-:9.7:-

Convert the following number from base ten to base two.

808

SOLUTION

2	808	Reminder
2	404	 0
2	202	 0
2	101	 0
2	50	 1
2	25	 0
2	12	 1
2	6	 0
2	3	 0
	1	 1

 $(1100101000)_2$

-:9.8:-

Convert the following number from base ten to base two.

2525

SOLUTION

2	2525	Reminder
2	1262	 1
2	631	 0
2	315	 1
2	157	 1
2	78	 1
2	39	 0
2	19	 1
2	9	 1
2	4	 1
2	2	 0
	1	 0

 $(100111011101)_2$

-:9.9:-

Convert the following number from base two to base ten.

 $(10101)_2$ **SOLUTION** $(10101)_2$

2^4	2^3	2^2	2^1	2^0
1	0	1	0	1

OR

16	8	4	2	1
1	0	1	0	1

 $(10101)_2$

$$= (1 \times 16) + (0 \times 8) + (1 \times 4) + (0 \times 2) + (1 \times 1)$$

$$= 16 + 0 + 4 + 0 + 1 = 16 + 4 + 1 = 21$$

-:9.10:-

Convert the following number from base two to base ten.

 $(11111)_2$ **SOLUTION** $(11111)_2$

2^4	2^3	2^2	2^1	2^0
1	1	1	1	1

OR

16	8	4	2	1
1	1	1	1	1

 $(11111)_2$

$$= (1 \times 16) + (1 \times 8) + (1 \times 4) + (1 \times 2) + (1 \times 1)$$

$$= 16 + 8 + 4 + 2 + 1 = 31$$

-:9.11:-

Convert the following number from base two to base ten.

 $(100000)_2$ **SOLUTION** $(100000)_2$

2^5	2^4	2^3	2^2	2^1	2^0
1	0	0	0	0	0

OR

32	16	8	4	2	1
1	0	0	0	0	0

 $(100000)_2$

$$= (1 \times 32) + (0 \times 16) + (0 \times 8) + (0 \times 4) + (0 \times 2) + (0 \times 1)$$

$$= 32 + 0 + 0 + 0 + 0 + 0 = 32$$

-:9.12:-

Convert the following number from base two to base ten.

 $(101001)_2$ **SOLUTION** $(101001)_2$

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

OR

64	32	16	8	4	2	1
1	0	1	1	0	0	1

$$\begin{aligned}
 (101001)_2 &= (1 \times 64) + (0 \times 32) + (1 \times 16) + (1 \times 8) + (0 \times 4) + (0 \times 2) + (1 \times 1) \\
 &= 64 + 0 + 16 + 8 + 0 + 0 + 1 \\
 &= 64 + 16 + 8 + 1 = 89
 \end{aligned}$$

-:9.13:-

Convert the following number from base two to base ten.

 $(11100111)_2$ **SOLUTION** $(11100111)_2$

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

OR

128	64	32	16	8	4	2	1
1	1	1	0	0	1	1	1

$$\begin{aligned}
 (11100111)_2 &= (1 \times 128) + (1 \times 64) + (1 \times 32) + (0 \times 16) + (0 \times 8) + (1 \times 4) \\
 &\quad + (1 \times 2) + (1 \times 1) \\
 &= 128 + 64 + 32 + 0 + 0 + 4 + 2 + 1 \\
 &= 128 + 64 + 32 + 4 + 2 + 1 = 231
 \end{aligned}$$

-:9.14:-

Convert the following number from base two to base ten.

 $(1001001001)_2$ **SOLUTION** $(1001001001)_2$

2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	0	0	1	0	0	1	0	0	1

OR

512	256	128	64	32	16	8	4	2	1
1	0	0	1	0	0	1	0	0	1

$$\begin{aligned}
 (1001001001)_2 &= (1 \times 512) + (0 \times 256) + (0 \times 128) + (1 \times 64) + (0 \times 32) + (0 \times 16) \\
 &\quad + (1 \times 8) + (0 \times 4) + (0 \times 2) + (1 \times 1) \\
 &= 512 + 0 + 0 + 64 + 0 + 0 + 8 + 0 + 0 + 1 \\
 &= 512 + 64 + 8 + 1 = 585
 \end{aligned}$$

-:9.15:-

Convert the following number from base two to base ten.

 $(111111000)_2$ **SOLUTION** $(111111000)_2$

2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	1	1	1	1	0	0	0

OR

256	128	64	32	16	8	4	2	1
1	1	1	1	1	1	0	0	0

$$\begin{aligned}
 (111111000)_2 &= 1 \times 256 + (1 \times 128) + (1 \times 64) + (1 \times 32) + (1 \times 16) + (1 \times 8) + (0 \times 4) \\
 &\quad + (0 \times 2) + (0 \times 1) \\
 &= 256 + 128 + 64 + 32 + 16 + 8 + 0 + 0 + 0 \\
 &= 256 + 128 + 64 + 32 + 16 + 8 = 504
 \end{aligned}$$

Adding in base two check by converting to base ten.

-:9.16:-

$$\begin{array}{r}
 1011 \\
 1011 \\
 \hline
 110000
 \end{array}$$

-:9.18:-

$$\begin{array}{r}
 11010 \\
 10111 \\
 \hline
 110001
 \end{array}$$

-:9.17:-

$$\begin{array}{r}
 1101 \\
 1101 \\
 \hline
 11000
 \end{array}$$

-:9.19:-

$$\begin{array}{r}
 101111 \\
 111011 \\
 101101 \\
 \hline
 10010111
 \end{array}$$

-:9.20:-

1111
1111
1111
101101

-:9.22:-

1111111
1110101
1101011
1110100
111010011

-:9.24:-

11011101
10111011
11100111
10111011
1100111010

-:9.26:-

1101011
- 111101
101110

-:9.28:-

11111111
- 1111111
10000000

-:9.30:-

111011011
- 101010000
10001011

-:9.21:-

11011
11100
10111
1001110

-:9.23:-

1110001
1011101
1001101
1101010
110000101

-:9.25:-

1011010
- 100101
110101

-:9.27:-

110000
- 11011
10101

-:9.29:-

11011011
- 101011
10110000

-:9.31:-

101
111
101
101x
101xx
100011

-:9.32:-

```

    1011
      111
-----
    1011
    1011x
    1011xx
-----
    1001101
-----

```

-:9.34:-

```

    110111
      10101
-----
    110111
    000000x
    110111xx
    000000xxx
    110111xxxx
-----
    10010000011
-----

```

-:9.36:-

```

    1111011
      111011
-----
    1111011
    1111011x
    0000000xx
    1111011xxx
    1111011xxxx
    1111011xxxxx
-----
    1110001011001
-----

```

-:9.33:-

```

    11111
      1100
-----
    00000
    00000x
    11111xx
    11111xxx
-----
    101110100
-----

```

-:9.35:-

```

    11111
      1001
-----
    11111
    00000x
    00000xx
    11111xxx
-----
    100010111
-----

```

-:9.37:-

```

    111111
      11111
-----
    111111
    111111x
    111111xx
    111111xxx
    111111xxxx
-----
    11110100001
-----

```

:-9.38:-

$$\begin{array}{r}
 (11001)_2 \div (101)_2 \\
 \underline{101} \\
 101 \overline{)1111} \\
 \underline{101} \\
 101 \\
 \underline{101} \\
 x \\
 (101)_2
 \end{array}$$

:-9.40:-

$$\begin{array}{r}
 (1110111)_2 \div (11010)_2 \\
 \underline{10} \\
 11010 \overline{)111011} \\
 \underline{11010} \\
 111 \\
 (10)_2 \text{ with remainder} \\
 (111)_2
 \end{array}$$

:-9.39:-

$$\begin{array}{r}
 (110110)_2 \div \\
 (1001)_2 \\
 \underline{110} \\
 1001 \overline{)110110} \\
 \underline{1001} \\
 1001 \\
 \underline{1001} \\
 x \\
 (110)_2
 \end{array}$$

:-9.41:-

$$\begin{array}{r}
 (1011010110)_2 \div \\
 (10110)_2 \\
 \underline{100001} \\
 10110 \overline{)1011010110} \\
 \underline{10110} \\
 10110 \\
 \underline{10110} \\
 x \\
 (100001)_2
 \end{array}$$

:-9.42:

$$\begin{array}{r}
 \frac{1}{2} \\
 1 = 1_2 \\
 2 = 10_2 \\
 \frac{1}{2} = \frac{1_2}{10_2} \\
 \underline{0.1} \\
 10 \overline{)10} \\
 \underline{10} \\
 x \\
 (0.1)_2
 \end{array}$$

Alternative method

$$\frac{1}{2} = 0.5$$

Multiplying by two

$$\begin{array}{r}
 0.5 \\
 \underline{2} \\
 1 \dots\dots 1.0 \\
 (0.1)_2
 \end{array}$$

-:9.43:-

$$\frac{1}{4}$$

$$1 \quad 1_2$$

$$4 = 100_2$$

$$\frac{0.01}{100 \overline{)100}}$$

$$\frac{100}{\quad}$$

$$\times$$

$$\text{Hence } \frac{1}{4} = (0.01)_2$$

Alternative method

$$\frac{1}{4} = 0.25$$

Multiplying by two

$$\begin{array}{r} 0.25 \\ \times 2 \\ \hline 0.50 \\ \times 2 \\ \hline 1.00 \end{array}$$

-:9.44:-

Alternative method

$$\frac{3}{4} = (0.75)_2$$

$$\frac{3}{4}$$

$$3 = 11_2 \text{ and } 4 = 100_2$$

$$\frac{0.11}{100 \overline{)110}}$$

$$\frac{100}{\quad}$$

$$\frac{100}{\quad}$$

$$\frac{100}{\quad}$$

$$\times$$

$$\text{Hence } \frac{3}{4} = (0.11)_2$$

$$\begin{array}{r} 0.75 \\ \times 2 \\ \hline 1.50 \\ \times 2 \\ \hline 3.00 \end{array}$$

-:9.45:-

$$\frac{24}{60} = \frac{2}{5}$$

$$\frac{2}{5} = \frac{(100)_2}{(101)_2}$$

$$\begin{array}{r} 101 \overline{)1000} \quad (11001100110011 \dots) \\ \underline{101} \\ 1000 \\ \underline{101} \\ 110 \\ \underline{101} \\ 1 \end{array}$$

$$\frac{24}{60} = (0.11001100110011 \dots)_2$$

-:9.46:-

$$\frac{72}{120} = \frac{3}{5}$$

$$3 = (11)_2$$

$$5 = (101)_2$$

$$\frac{72}{120} = (0.1001100110011\dots)_2$$

$$\begin{array}{r} 101 \overline{)110} \quad (100110011\dots) \\ \underline{101} \\ 1000 \\ \underline{101} \\ 1000 \\ \underline{101} \\ 110 \\ \underline{101} \\ 1 \end{array}$$

-:9.47:-

Convert each of the following binary numbers in decimal.

 $(111.11)_2$ **SOLUTION**

2^2	2^1	2^0	2^{-1}	2^{-2}
1	1	1	1	1

OR

4	2	1	$\frac{1}{2}$	$\frac{1}{4}$
1	1	1	1	1

$$\begin{aligned} (111.11)_2 &= (1 \times 4) + (1 \times 2) + (1 \times 1) + (1 \times \frac{1}{2}) + (1 \times \frac{1}{4}) \\ &= 4 + 2 + 1 + \frac{1}{2} + \frac{1}{4} = 4 + 2 + 1 + 0.5 + 0.25 = 7.75 \end{aligned}$$

-:9.48:-

Convert each of the following binary numbers in decimal.

 $(1110.111)_2$ **SOLUTION**

2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}
1	1	0	1	1	1

OR

4	2	1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$
1	1	0	1	1	1

$$\begin{aligned}
 (110.111)_2 &= (1 \times 4) + (1 \times 2) + (0 \times 1) + (1 \times \frac{1}{2}) + (1 \times \frac{1}{4}) + (1 \times \frac{1}{8}) \\
 &= 4 + 2 + 0 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} \\
 &= 4 + 2 + 0.5 + 0.25 + 0.125 = 6.875
 \end{aligned}$$

∴ 9.49:-

Convert each of the following binary numbers in decimal.

$(1111.111)_2$

SOLUTION

2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}
1	1	1	1	1	1	1

OR

8	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$
1	1	1	1	1	1	1

$$\begin{aligned}
 (1111.111)_2 &= (1 \times 8) + (1 \times 4) + (1 \times 2) + (1 \times 1) + (1 \times \frac{1}{2}) + (1 \times \frac{1}{4}) + (1 \times \frac{1}{8}) \\
 &= 8 + 4 + 2 + 1 + 0.5 + 0.25 + 0.125 = 15.875
 \end{aligned}$$

∴ 9.50:-

Convert each of the following binary numbers in decimal.

$(101010.001)_2$

SOLUTION

2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}
1	0	1	0	1	0	0	0	1

OR

32	16	8	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$
1	0	1	0	1	0	0	0	1

$$\begin{aligned}
 (101010.001)_2 &= (1 \times 32) + (0 \times 16) + (1 \times 8) + (0 \times 4) + (1 \times 2) + (0 \times 1) + (0 \times \frac{1}{2}) \\
 &\quad + (0 \times \frac{1}{4}) + (1 \times \frac{1}{8}) \\
 &= 32 + 0 + 8 + 0 + 2 + 0 + 0 + 0 + \frac{1}{8} \\
 &= 32 + 8 + 2 + 0.125 = 42.125
 \end{aligned}$$