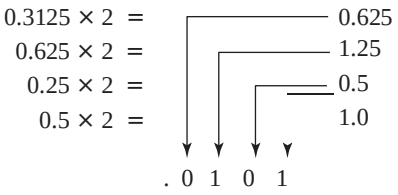
The fractional part is repeatedly multiplied by 2 giving:



Thus $58.3125_{10} = 111010.0101_2$

Now try the following exercise

Exercise 18 Further problems on conversion of denary to binary numbers (Answers on page 272)

In Problems 1 to 4, convert the denary numbers given to binary numbers.

1. (a) 5 (b) 15 (c) 19 (d) 29
2. (a) 31 (b) 42 (c) 57 (d) 63
3. (a) 0.25 (b) 0.21875 (c) 0.28125 (d) 0.59375
4. (a) 47.40625 (b) 30.8125
   (c) 53.90625 (d) 61.65625

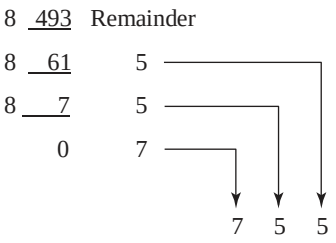
5.4 Conversion of denary to binary via octal

For denary integers containing several digits, repeatedly dividing by 2 can be a lengthy process. In this case, it is usually easier to convert a denary number to a binary number via the octal system of numbers. This system has a radix of 8, using the digits 0, 1, 2, 3, 4, 5, 6 and 7. The denary number equivalent to the octal number 4317_8 is

$$4 \times 8^3 + 3 \times 8^2 + 1 \times 8^1 + 7 \times 8^0$$

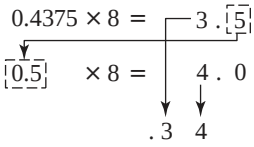
i.e. $4 \times 512 + 3 \times 64 + 1 \times 8 + 7 \times 1$ or 2255_{10}

An integer denary number can be converted to a corresponding octal number by repeatedly dividing by 8 and noting the remainder at each stage, as shown below for 493_{10}



Thus $493_{10} = 755_8$

The fractional part of a denary number can be converted to an octal number by repeatedly multiplying by 8, as shown below for the fraction 0.4375_{10}



For fractions, the most significant bit is the top integer obtained by multiplication of the denary fraction by 8, thus

$$0.4375_{10} = 0.34_8$$

The natural binary code for digits 0 to 7 is shown in Table 5.1, and an octal number can be converted to a binary number by writing down the three bits corresponding to the octal digit.

Table 5.1

Octal digit	Natural binary number
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	111

Thus $437_8 = 100\,011\,111_2$

and $26.35_8 = 010\,110.011\,101_2$

The '0' on the extreme left does not signify anything, thus $26.35_8 = 10\,110.011\,101_2$

Conversion of denary to binary via octal is demonstrated in the following worked problems.

Problem 7. Convert 3714_{10} to a binary number, via octal.

Dividing repeatedly by 8, and noting the remainder gives: