From Table 5.1, $7202_8 = 111\,010\,000\,010_2$

i.e. $\mathbf{3714_{10} = 111\,010\,000\,010_2}$

Problem 8. Convert 0.59375_{10} to a binary number, via octal.

Multiplying repeatedly by 8, and noting the integer values, gives:

$0.59375 \times 8 = 4.75$
$0.75 \times 8 = 6.00$

. 4 6

Thus $0.59375_{10} = 0.46_8$

From Table 5.1, $0.46_8 = 0.100\,110_2$

i.e. .... $\mathbf{0.59375_{10} = 0.100\,11_2}$

Problem 9. Convert 5613.90625_{10} to a binary number, via octal.

The integer part is repeatedly divided by 8, noting the remainder, giving:

		Remainder
8	5613	
8	701	5
8	87	5
8	10	7
8	1	2
	0	1

1 2 7 5 5

This octal number is converted to a binary number, (see Table 5.1)

$12755_8 = 001\,010\,111\,101\,101_2$

i.e. $5613_{10} = 1\,010\,111\,101\,101_2$

The fractional part is repeatedly multiplied by 8, and noting the integer part, giving:

$0.90625 \times 8 = 7.25$
$0.25 \times 8 = 2.00$

. 7 2

This octal fraction is converted to a binary number, (see Table 5.1)

$0.72_8 = 0.111\,010_2$

i.e. $0.90625_{10} = 0.111\,01_2$

Thus, $\mathbf{5613.90625_{10} = 1\,010\,111\,101\,101.111\,01_2}$

Problem 10. Convert $11\,110\,011.100\,01_2$ to a denary number via octal.

Grouping the binary number in three's from the binary point gives: $011\,110\,011.100\,010_2$

Using Table 5.1 to convert this binary number to an octal number gives: 363.42_8 and

$$363.42_8 = 3 \times 8^2 + 6 \times 8^1 + 3 \times 8^0 + 4 \times 8^{-1} + 2 \times 8^{-2}$$
$$= 192 + 48 + 3 + 0.5 + 0.03125$$
$$= \mathbf{243.53125_{10}}$$

Now try the following exercise

Exercise 19 Further problems on conversion between denary and binary numbers via octal (Answers on page 272)

In Problems 1 to 3, convert the denary numbers given to binary numbers, via octal.

1. (a) 343 (b) 572 (c) 1265
2. (a) 0.46875 (b) 0.6875 (c) 0.71875
3. (a) 247.09375 (b) 514.4375 (c) 1716.78125
4. Convert the following binary numbers to denary numbers via octal:
5. (a) 111.011 1 (b) 101 001.01

   (c) 1 110 011 011 010.001 1

5.5 Hexadecimal numbers

The complexity of computers requires higher order numbering systems such as octal (base 8) and hexadecimal (base 16) which are merely extensions of the binary system. A **hexadecimal numbering system** has a radix of 16 and uses the following 16 distinct digits:

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

'A' corresponds to 10 in the denary system, B to 11, C to 12, and so on.

To convert from hexadecimal to decimal:

For example $1A_{16} = 1 \times 16^1 + A \times 16^0$
$= 1 \times 16^1 + 10 \times 1 = 16 + 10 = 26$

i.e. $\mathbf{1A_{16} = 26_{10}}$

Similarly, $\mathbf{2E_{16}} = 2 \times 16^1 + E \times 16^0$
$= 2 \times 16^1 + 14 \times 16^0 = 32 + 14 = \mathbf{46_{10}}$