There are many types of bar codes in use today. One which is increasingly used in the Health Service (e.g. for labelling blood samples) is the Code 3 of 9. It was first designed in 1974 in the USA. The diagram below shows an example of this code. Each code starts and ends with an asterisk (*).

Every letter or number within the code is made up of 9 elements, 5 bars and 4 spaces, with 3 of the bars and spaces thicker than the others. There is also a thin white space between each of the coded characters when they are combined together.

Individual elements of the bar code above are shown opposite. The codes are shown in a binary code on the far right, using 1 for thick and 0 for thin.

### Example 1

From the code shown above, identify * and then deduce the code for +.

### Solution

Starting on the left, you can see that for BARS we have 0 0 1 1 0 and for SPACES, 1 0 0 0. This gives

<table>
<thead>
<tr>
<th>BARS</th>
<th>SPACES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 1 1 0</td>
<td>1 0 0 0</td>
</tr>
</tbody>
</table>

Note that the thick (1) bars or spaces are twice as thick as the thin (0) bars or spaces.

After the space, you can see that the next 5 BARS are 0 0 0 0 0 and the next 4 SPACES give 1 0 1 1. Hence the code for + is

<table>
<thead>
<tr>
<th>BARS</th>
<th>SPACES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0 0 0</td>
<td>1 0 1 1</td>
</tr>
</tbody>
</table>
Exercise 1

*For the code above, identify 1 and deduce the codes for 2 and 3.*

The advantage of this code compared with the 8-digit and 13-digit EAN bar codes often used on grocery products is that it can be used for both numbers and letters.

Activity 1

a) How many different patterns are there with one '1' and three '0's.

b) How many different patterns are there with two '1's and three '0's?

c) Deduce the number of different combinations possible for codes using exactly two thick bars and one thick space. Is this sufficient to be able to code uniquely all letters from A to Z and all numbers from 1 to 9?

d) If there are exactly three thick bars or spaces, how many possible combinations are there?

You should have deduced that there are 40 possible codes; the full coded list is given in Appendix 1.

Exercise 2

*Use the details in Appendix 1 to decode:*

Example

Code *AYR4* (Use the grid in Appendix 2 to help.)

Solution

| BARS | 1 0 0 0 1 | 1 0 1 0 0 | 1 0 0 1 0 | 0 0 1 0 1 |
| SPACES | 0 0 1 0 | 1 0 0 0 | 0 0 0 1 | 0 1 0 0 |

You can also code messages using the table in Appendix 1.
Exercise 3

*Code *3.14* using the grid in Appendix 2.*

Activity 2

What are the advantages/disadvantages of this type of bar code?
# Appendix 1

Character table  
(Note that * is used for the start/stop which must precede and follow every code 3 of 9 message.)
Appendix 2

GRIDS

(A) Four letters / words

(B) Five letters / words

(C) Six letters / words