TEACHER NOTES AND SOLUTIONS

Bar codes have a pattern in their digits to help detect errors: the sum of the odd positions plus three times the even positions is always a multiple of ten. A magic trick can be made where one person reads out the first 12 digits on the bar code of a product, and the second person 'predicts' the check digit by using the pattern in the digits. These resources help you teach your class to do this trick and think about the maths that makes it work.

Which type of bar codes?

The method in these activities applies to bar codes which have 13 digits (where the first digit is to the left of the first vertical stripe). The method described only works for these 13-digit bar codes so does not work for barcodes on a book, or from product in a multipack or supermarket own-brand product. These other types of bar codes do have check digits, but the calculation is not the same.

Bar code background information

A bar code is a set of stripes which represent the digits written beneath the barcode. The first 12 digits tell us the identity of the product, so when the bar code is scanned the computer can update stock levels and charge the customer the correct price.

The digit at the end is a special digit called the check digit. The check digit is chosen to be the answer to a particular calculation that is done with the first 12 digits. The bar code scanner reads the first 12 digits (actually it reads the stripes that represent those digits), does a calculation with those digits and then checks that the answer it gets is the same as the check digit. If they match, then the bar code scanner knows it has correctly read the bar code.

A magic trick can be made where one person reads out the first 12 digits on the bar code of a product, and the second person 'predicts' the check digit by doing this calculation.

Activity notes

You could start by doing the trick on your students!

Then you could discuss what bar codes are and the role that the check digit has, before showing the example calculation (see the example sheet) and the students then trying the activities in the Bar Code Trick Task sheet.

Once students have got the hang of the method, you could have a discussion about how the tens digit of the sum does not matter. It's only the units digit of **SUM A + 3 × SUM B** that determines what the check digit is.

Bar Code Trick Sheet Solutions

Page 1

1^{st}	3^{rd}	5^{th}	7^{th}	9^{th}	11^{th}	**SUM A**
4	**7**	**8**	**0**	**0**	**9**	**28**

2^{nd}	4^{th}	6^{th}	8^{th}	10^{th}	12^{th}	**SUM B**
9	**1**	**5**	**9**	**1**	**4**	**29**

Step 2: **SUM A + 3 × SUM B = 115**

Step 3: **Check digit = 5**

Page 2

Left to right, the check digits for the six bar codes are: **8, 8, 6, 3, 2, 6**

Extension

Students can work backwards and find a digit that fits to make the check digit work. In both questions let's call the missing digit **y**

First question

3 x SUM B = 48

SUM A = **y** + 18

Check digit = 4

y + 18 + 48 + 4 is a multiple of 10.

y + 70 is a multiple of 10, therefore **y = 0**.

Second question

SUM A = 36

Check digit = 9

SUM B = 27 + **y**

36 + 3(27 + **y**) + 9 is a multiple of 10

45 + 3(27 + **y**) is a multiple of 10

45 + 81 + 3**y** is a multiple of 10

126 + 3**y** is a multiple of 10

3**y** has to have a unit digit of 4. **y = 8** is the only single digit value that gives a unit digit of 4 for 3**y**.

Further discussion

A discussion could be had (or a further activity created) which investigates the one-to-one relationship (shown by the diagram below) between the single digit numbers, and the unit digit that is created when that number is multiplied by 3. This one-to-one relationship is crucial for allowing there to be only one possible answer in the second of the extension questions above.