Check digits

A **check digit** is an additional digit at the end of a string of other numbers designed to check for mistakes in input or transmission. Printed books and other products have a unique ISBN (International Standard Book Number), a 13-digit number which includes the calculated check digit and is printed with the barcode. The first 12 digits are the unique item number, the 13th is the check digit. This can be calculated using the **Modulo 10** system.

For example, the ISBN or EAN of 978095614305 has a check digit of 1, calculated as follows:

ISBN	**9**	**7**	**8**	**0**	**9**	**5**	**6**	**1**	**4**	**3**	**0**	**5**	1
Weight	1	3	1	3	1	3	1	3	1	3	1	3	
Multiplication	9	21	8	0	9	15	6	3	4	9	0	15	
Addition	Add all the numbers												99
Remainder	Find the remainder when divided by 10												9
Subtraction	Subtract the result from 10												1

The ISBN digits are given weights of 1 and 3 alternatively. Each value is multiplied by its weight. The multiplied values are added together and divided by 10 to get a remainder of 9. The remainder is subtracted from 10 to give a check digit of 1. The published check digit is read by a barcode scanner, an algorithm to check the check digit is performed and if, as in this case, the digits match, the barcode is deemed, with almost 100% accuracy, to have been read accurately.

A similar system works with credit card numbers.

Q12 Use the Modulo 10 system to check the check digit on a product or book barcode.

Using check digits for parity

A **parity bit** is an additional bit that is used to check that the other bits transmitted are likely to be correct. Using 7-bit ASCII with an 8-bit system meant that there was an extra bit available. This was used as a parity bit.

Computers use either odd or even parity, and the parity bit is used to ensure that the total number of 1s in each byte, including the parity bit, equals an odd or even number. For example an R is represented by 1010010 in 7-bit ASCII:

0	**1**	**0**	**1**	**0**	**0**	**1**	**0**

Using odd parity, the parity bit above is the most significant bit, and becomes 0 to make the total number of 1s an odd number – in this case, 3. Using even parity, the parity bit would have been set to 1.

Q13 What would be the parity bit value for 0010110 using odd parity?