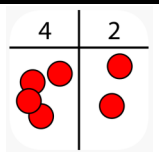
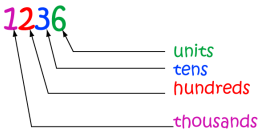
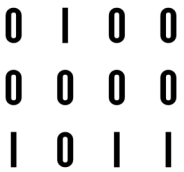
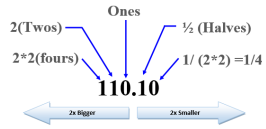
Y9—Binary

Important ideas

	Humans use the decimal number system. It has 9 digits (0-9). There are 10 different states in decimal. Columns to the left are 10 times bigger.
	All number systems have a 'place value'. Each time you count to ten you 'tally' in the next column. The columns indicate 10s,100s, 1000s etc.
	Computers use the binary number system which has two digits (0 and 1). They have to do this because logic gates can only be in two states. Zero can represent FALSE and 1 can represent TRUE.
	In binary, each time that you move from right to left, each column is twice as big as the previous column. In decimal it is ten times bigger.

Important vocabulary

Decimal (Denary)	A number system that uses 10 digits or symbols (0-9)
Binary	A number system that uses 2 digits (0 and 1)
Place value	**Place value** is the **value** of each digit in a number. It means understanding that 582 is made up of 5x100, 8x10 and 2X1, rather than 5, 8 and 2.
Digital	Only having two states (eg ON or OFF)
Bit	A binary digit

Quick recall facts

In the binary number system we use 2 digits (0 and 1). Every time that we are counting and we 'run out' of digits to use we 'tally' a digit in the next column to the left. This means that each column (on the left) is twice as big as the previous one.

2^3	2^2	2^1	2^0
8 Eights place	4 Fours place	2 Twos place	1 Ones place
1	**0**	**0**	**1**

The number 1001, in base 2 (or binary), is not the same as the number 1001 in base 10 (or decimal). 1001, in base 2, is (1x8)+(0x4)+(0x2)+(1x1) = 9 (in base 10).

We can convert binary to decimal (and decimal to binary) using simple rules.

How it connects...

In the decimal number system we use 9 digits (0-9). Every time that we are counting and when we 'run out' of digits to use we 'tally' a digit in the next column to the left. This means that each column (on the left) is 10 times bigger than the previous one.

Ten Thousands (T Th)	Thousands (Th)	Hundreds (H)	Tens (T)	Ones (O)
1	3	5	4	8

Place value of 1 = 10 000
Place value of 3 = 3 000
Place value of 5 = 500 → 13548
Place value of 4 = 40
Place value of 8 = 8

Computers use logic gates to process and store information.

Logic gates can only be in two states (ON or OFF). This means that computers can only process information given to them in a binary form. They can only **process information in a binary way** and they can only output information in a binary way.

The programs that are written by humans translate our world into a binary world (and back again)

Important examples

Converting a binary number into a decimal number	Convert 110_2 into a decimal number: 16 8 4 2 1 0 0 1 1 0 The answer is (1x4)+(1x2)+(0x1) = 6_{10}
Converting a decimal number into a binary number	Convert 28_{10} into binary (using factors): 16 8 4 2 1 1 1 1 0 0 To make 28 you need (1x16)+(1x8)+(1x4)+(0x2)+(0x1) = 28
Adding or subtracting binary numbers	Follow the simple rules: **0 + 0 =0 0 + 1 =1 1 + 1 = 0 (carry 1)** **1 + 1 + 1 = 1 (carry 1)**

I must be able to...

Identify the 'base' of a number (eg Base 10 or Base 2)	The number 10 can be a base 10 or a base 2 number. We can show this— 10_2 is a base 2 number. 10_{10} is a base 10 number. It's only numbers that are made of 1s and 0s that can be confusing.
Convert a binary number into decimal (using a table method)	1. Draw a table that has 5 columns and 2 rows 2. From right to left label the top columns as 1,2,4,8,16 and 32. 3. Put in your binary number. If a 1 appears then add that to every column that also has a 1 in it. The sum is your decimal.
Convert a decimal number into a binary number.	1. Divide your decimal number by 2. Record the outcome and any remainder (0 or 1) 2. Continue to divide by 2 until you have either zero or 1 left. 3. The remainders show your binary number.
Explain how computers store data and process data using logic gates.	• Logic gates are used for processing and for data storage. Logic gates can only exist in two states (ON or OFF). This means that they are binary. • A piece of data stored on a computer is a binary digit (bit).