# AQA Computer Science A-Level

## 4.5.3 Units of information

Advanced Notes

**Specification:**

**4.5.3.1 Bits and bytes:**

Know that:

- the bit is the fundamental unit of information
- a byte is a group of 8 bits

Know that the $2^n$ different values can be represented with n bits.

**4.5.3.2 Units:**

Know that quantities of bytes can be described using binary prefixes representing powers of 2 or using decimal prefixes representing powers of 10, eg one kibibyte is written as 1KiB = $2^{10}$ B and one kilobyte is written as 1kB = $10^3$ B.

Know the names, symbols and corresponding powers of 2 for the binary prefixes:

- kibi, Ki - $2^{10}$
- mebi, Mi - $2^{20}$
- gibi, Gi - $2^{30}$
- tebi, Ti - $2^{40}$

Know the names, symbols and corresponding powers of 10 for the decimal prefixes:

- kilo, k - $10^3$
- mega, M - $10^6$
- giga, G - $10^9$
- tera, T - $10^{12}$

# Bits and bytes

A bit is the fundamental unit of information that can only take two values, 1 and 0, which can be represented by computers using high or low currents.

A collection of 8 bits is called a byte. Half a byte (4 bits) is called a nybble.

A bit is notated with a lowercase b whereas a byte uses the uppercase.

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2b = 2 bits
3B = 3 bytes = 3 * 8 bits = 24 bits
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The number of different values that can be represented with a specified number of bits varies with the number of bits. The more bits that are assigned to a number, the greater the number of values that can be represented.

More specifically, there are $2^n$ different values that can be represented with n bits.

For example, using just 2 bits, there are four ($2^2$) possible permutations of the bits and hence four different values that can be represented, as shown below.

| 00 | 01 | 10 | 11 |
|---|---|---|---|
| $= 0_{10}$ | $= 1_{10}$ | $= 2_{10}$ | $= 3_{10}$ |

If we use a byte (8 bits), there are 256 ($2^8$) different values that can be represented.

The range of values that can be represented with a specified number of bits also depends on the number of bits. This is covered in more detail in the binary number system notes.

**Synoptic Link**

A subscript 10 denotes that the decimal **number base** is being used.

Different subscript notations are covered in **number bases**.

# Units

Quantities of bytes can be described using binary prefixes or decimal prefixes. Binary prefixes go up in powers of two whereas decimal prefixes go up in powers of ten.

You will be familiar with decimal prefixes from everyday life. For example, 1000 grams is 1 kilogram. Binary prefixes are not used as frequently as decimal prefixes but they have similar orders of magnitude.

| Binary | | Decimal | |
|---|---|---|---|
| **Prefix** | **Value** | **Prefix** | **Value** |
| Kibi (Ki) | $2^{10}$ = 1024 | Kilo (K) | $10^{3}$ = 1000 |
| Mebi (Mi) | $2^{20}$ = 1048576 | Mega (M) | $10^{6}$ = 1000000 |
| Gibi (Gi) | $2^{30}$ = 1073741824 | Giga (G) | $10^{9}$ = 1000000000 |
| Tebi (Ti) | $2^{40}$ ≈ $1.0995\times10^{12}$ | Tera (T) | $10^{12}$ = $1\times10^{12}$ |

1 Kib = 1 kibibit = $2^{10}$ bits

1 KiB = 1 kibibyte = $2^{10}$ bytes = $2^{10}$ * 8 bits = 8192 bits

1 GB = 1 gigabyte = $10^{9}$ bytes = $10^{9}$ * 8 bits= $8\times10^{9}$ bits