**Units of measurement – Storage**

Binary dictates that we have only 1 and 0 in the language, since this corresponds to ON and OFF as an electrical signal.

Each 1 or 0 is a **bit**. Sometimes we group in sets of 8. Each set of 8 is called a **byte.**

The peculiarity of counting in 1s and 0s (also known as **base 2**) is that unlike decimal, when we have many bytes, we don’t always get round numbers. This isn’t a huge problem for small numbers, but it is for whole ones.

Consider a megabyte – around 1 million bytes. We can arrive at this number by doubling from 1: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768, 65536, 131,072, 262,144, 524,288, **1,048,576** bytes.

The problem is that 1,048,576 bytes is not the same as 1,000,000 bytes. We’re trying to fuse base 2 with base 10 (decimal) and this causes confusion, especially when these terms are interchangeable depending on the area of computer science you’re looking at! The definitions you’re looking at here are the SI definitions – the standards.

For this reason we count the units using two different systems. Each system uses similar aggregations.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Base 2 (2^n = x)** | | | **Base 10 (10^n = x)** | | |
| *Term* | *n* | *Number of Bytes (x)* | *Term* | *n* | *Number of Bytes (x)* |
| Byte | - | 1 | Byte | - | 1 |
| Kibibyte | 10 | 1024 | Kilobyte | 3 | 1000 |
| Mebibyte | 20 | 1,048,576 | Megabyte | 6 | 1,000,000 |
| Gibibyte | 30 | 1,073,741,824 | Gigabyte | 9 | 1,000,000,000 |
| Tebibyte | 40 | 1,099,511,627,776 | Terabyte | 12 | 1,000,000,000,000 |
| Pebibyte | 50 | 1,125,899,906,842,624 | Petabyte | 15 | 1,000,000,000,000,000 |

We shorten these terms using B, KB, MB, GB, TB and PB regardless of which system we’re using.

Note we can express larger units in terms of smaller ones   
- i.e. 1024KB = 1MB (in base 2) or 1000KB = 1MB (in base 10).

If you’re required to do any calculations in the exam, the exam will specify which system to use.

*Important note! Sometimes you’ll see these units expressed with a lowercase b.*

*This notation expresses kibi/kilo, mebi/mega etc. bits, not bytes, and you’ll normally only see this used when you read about bandwidth or network speed. E.g. 100Mbps means 100 megabits per second, not megabytes.*

Exercises

1. Using base 10, express 10,000 bytes in terms of kilobytes.
2. Using base 2, express 4,096 kibibytes in terms of mebibytes.
3. How many terabytes are in a petabyte?
4. I have an 8GB (base 2) USB drive. I have used 75% of the available space.  
   How much space, **in bytes**, is available on the disk?

I have a file that is 2.1GB (base 10) in size. Will it fit on the disk?