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# Binary Starter Pack

A focused introduction to binary for IGCSE Computer Science. Covers the key concepts, conversions, and vocabulary you need to know.

## What Is Binary?

Binary is a number system that uses only two digits: **0** and **1**. Computers use binary because their electronic circuits have two states — **ON (1)** and **OFF (0)**. Everything a computer does is built from these two values.

**KEY FACT: Binary uses only 0 and 1. Circuits use ON and OFF states.**

*Teacher note: Good entry point for discussion. Ask students: why can't computers use 0–9 like we do? The answer leads naturally into how transistors work as switches.*

## Bits and Bytes

A **bit** is a single binary digit — the smallest unit of data. Eight bits grouped together form a **byte**, used to store one character of text. A **nibble** is 4 bits — half a byte.

| Unit | Size | Example |
|---|---|---|
| Bit | 1 binary digit | 0 or 1 |
| Nibble | 4 bits | 1011 |
| Byte | 8 bits | 01001101 |

**KEY FACT: 1 byte = 8 bits. 1 nibble = 4 bits.**

*Teacher note: Students often lose marks confusing bit and byte. Memory hook: "a Byte is Bigger" — capital B in KB, MB, GB always means bytes.*

## Decimal to Binary

To convert a decimal number to binary, **divide by 2 repeatedly** and record the remainders. Read the remainders from **bottom to top** to get your binary answer. For example: 25 → 00011001.

Example: 25 in denary = **00011001** in binary

**KEY FACT: Divide by 2 repeatedly. Read remainders from bottom to top.**

*Teacher note: Walk students through 25 ÷ 2 step by step on the board. A common error is reading remainders top-to-bottom — emphasise the direction matters.*

## Binary to Decimal

Each binary digit represents a **power of 2**. Write the place values above each bit, then add up the values where a **1** appears. Place values always run: 128, 64, 32, 16, 8, 4, 2, 1.

| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |

Example: 00011001 = 16 + 8 + 1 = **25**

**KEY FACT: Each binary digit represents a power of 2. Add values where 1 appears.**

*Teacher note: Remind students they can always write the place value row in an exam — it costs seconds and prevents errors. Cambridge awards marks for working shown.*

## Binary Addition

Binary addition works column by column. When the result exceeds 1, carry to the next column. **Overflow** occurs when the result needs more bits than are available — the extra bit is lost.

| Sum | Result | Carry |
|---|---|---|
| 0 + 0 | 0 | 0 |
| 0 + 1 | 1 | 0 |
| 1 + 1 | 0 | 1 ← carry |
| 1 + 1 + 1 | 1 | 1 ← carry |

**KEY FACT: Overflow happens when the result needs more bits than are available.**

*Teacher note: Overflow is a frequent exam question. Ask: what happens if we add 11111111 + 00000001 in 8 bits? The result wraps to 00000000 — students should identify this as overflow and explain why the result is incorrect.*

## ASCII and Unicode

**ASCII** uses 7 bits to represent 128 characters — letters, digits, and basic symbols, English only. **Unicode** supports over 143,000 characters, covering virtually every language and symbol system in the world.

| Standard | Bits | Characters | Use |
|---|---|---|---|
| ASCII | 7 | 128 | English only |
| Unicode | 16–32 | 143,000+ | All world languages |

**KEY FACT: Unicode supports more languages and symbols than ASCII.**

*Teacher note: Ask students: why does Unicode matter for modern software? Emoji, Arabic script, Chinese characters — all rely on Unicode. Good real-world discussion point.*

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## Practice Questions

| | |
|---|---|
| **1.** | Define binary. |
| **2.** | How many bits are in one byte? |
| **3.** | Convert 25 denary into binary. |
| **4.** | Convert 101101 binary into decimal. |

*Answers on the next page →*

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## Answer Sheet

| | |
|---|---|
| 1. | Binary is a number system using only 0 and 1. |
| 2. | 1 byte = 8 bits. |
| 3. | 25 denary = 00011001 binary. |
| 4. | 101101 binary = 45 denary. |