A1 COMPUTER FUNDAMENTALS · A1.2

Data representation and computer logic

Binary, denary, and **hexadecimal**; how bits store text, images, and sound; and the **logic gates**, truth tables, and diagrams behind every circuit. Boolean algebra and Karnaugh maps are HL only.

01 Number systems

Binary	Base 2. Each column is a power of 2.
Denary	Base 10. The everyday digits.
Hex	Base 16. 0–9 then A–F (A=10 … F=15).
Bit	A single 0 or 1.
Byte	8 bits.
Nibble	4 bits = one hex digit.

02 Converting

Bin → den	Add the place-value columns holding a 1.
Den → bin	Divide by 2, read remainders bottom-up.
Bin → hex	Split into nibbles, convert each digit.
Worked	**10011010** = 154 = 9A
Pad	Fill to a full byte: 101101 → 00101101.

03 Binary stores everything

A

Text

ASCII = 1 byte per character (A = 65). Unicode (UTF-8) uses 1–4 bytes for every symbol and emoji.

B

Image

A grid of pixels. Colour depth = bits per pixel; resolution = width × height. Size ≈ w × h × depth.

C

Sound

Sampling rate (Hz) = samples per second. Bit depth = levels per sample. CD = 44.1 kHz · 16-bit.

04 Logic gates

AND	1 only if **both** inputs are 1.
OR	1 if **at least one** input is 1.
NOT	Inverts a single input.
NAND	AND then inverted (bubble on output).
NOR	OR then inverted.
XOR	1 only if inputs **differ**.

05 Truth tables

Rows	2^n rows for n inputs (2→4, 3→8).
Read	Left to right, one column at a time.

A · B	AND
0 0	0
0 1	0
1 0	0
1 1	1

06 Boolean algebra & Karnaugh maps · HL only

Algebra	Simplify with identities: A · 1 = A, A + 0 = A, A + (A · B) = A. Fewer gates for the same output.	HL ONLY
K-map	A truth table as a grid in Gray code, so neighbours differ by one variable. Group adjacent 1s in blocks of 1, 2, 4, or 8.	HL ONLY
Use	Up to about four variables. Each group collapses to one simpler term, with fewer slips than algebra alone.	HL ONLY

FINAL PASS BEFORE THE EXAM

Rapid exam tips

Eight things that lose marks in Paper 1 if you slip on them. Skim before you walk in.

01

Each binary column is a **power of 2**. Add only the columns that hold a 1.

02

Pad answers to a full **byte** when asked: 101101 becomes 00101101.

03

One hex digit = one **nibble** (4 bits). Group binary in fours from the right.

04

Resolution is pixel dimensions; **colour depth** is bits per pixel. Don't swap them.

05

Higher **sampling rate** captures higher frequencies; higher **bit depth** gives finer amplitude.

06

A bubble means **invert**. NAND and NOR are just AND and OR with a bubble.

07

XOR is 1 only when the inputs differ. It is not the same as OR.

08

Read diagrams and tables **left to right**. Boolean simplification and K-maps are **HL only**.