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Data Representation Cheat Sheet

A fast-reference cheat sheet by **FutureLogic Education** covering all key Data Representation topics for IGCSE Computer Science.

■ Section 1 — Binary & Hexadecimal

128	64	32	16	8	4	2	1

Binary	Base-2 number system — uses only 0 and 1.
Bit	A single binary digit (0 or 1) — smallest unit of data.
Nibble	4 bits — half a byte.
Byte	8 bits — stores one character.
Denary → Binary	Use place values. Work left to right. Pad to 8 bits.
Binary → Denary	Add place values where a 1 appears.
Overflow	Result too large for available bits — carry out of MSB.
Two's Complement	Step 1: Invert all bits. Step 2: Add 1. (Represents negatives.)

Hexadecimal Reference (each digit = 4 binary bits)

Hex	Binary	Hex	Binary
0	0000	8	1000
1	0001	9	1001
2	0010	A	1010
3	0011	B	1011
4	0100	C	1100
5	0101	D	1101
6	0110	E	1110
7	0111	F	1111

ASCII & Unicode

Standard	Bits	Characters
ASCII	7	128 — English only
Unicode	16–32	143,000+ — all languages

EXAM TIP: Hex: split binary into nibbles of 4 from right. Convert each nibble separately. Always pad to 8 bits.

Teacher note: Two's complement and overflow appear almost every year. Drill Step 1 → Step 2 until automatic.

■ Section 2 — Image Representation

Pixel	The smallest element of a digital image — stores a colour value.
Resolution	The number of pixels in an image. More pixels = more detail.
Colour Depth	The number of bits used to represent each pixel's colour.
Metadata	Data that describes the image — e.g. file size, date, camera settings.
Lossy Compression	Permanently removes some data to reduce file size. Not reversible.
Lossless Compression	Reduces file size with no permanent data loss. Fully reversible.

RLE	Run Length Encoding — stores repeating pixel values as value + count.

Image File Size = Width (px) × Height (px) × Colour Depth (bits)

Factors: Resolution • Colour depth • Compression

EXAM TIP: Resolution = number of pixels. Colour depth = bits per pixel. Do not confuse them — they are tested separately.

Teacher note: Lossy vs lossless is a frequent compare question. Key distinction: lossy = permanent loss, lossless = no loss, fully restorable.

■ Section 3 — Sound Representation

Sampling	Measuring the amplitude of a sound wave at regular time intervals.
Sample Rate	Number of samples taken per second — measured in Hz or kHz.
Sample Resolution	Number of bits used to store each sample (bit depth).
Sound File Size	Depends on sample rate, sample resolution, and duration.

Sound File Size = Sample Rate × Sample Resolution × Duration

Higher sample rate = more accurate sound = larger file size.

Higher sample resolution = more precise amplitude values = larger file size.

EXAM TIP: Sample rate = samples per second (Hz). Sample resolution = bits per sample. Mix these up and you lose marks instantly.

Teacher note: Explain questions on sound quality are common. Train students: "Higher sample rate because more samples are taken per second, therefore the sound wave is reproduced more accurately."

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■ Exam Tips & Final Checklist

✔ **Show binary working** Method marks are awarded even if the final answer is wrong.	✔ **Learn place values** Write 128 64 32 16 8 4 2 1 above every binary number.
✔ **Do not confuse resolution and colour depth** Resolution = pixels. Colour depth = bits per pixel.	✔ **Learn key definitions accurately** Use Cambridge terminology — vague answers lose marks.

■	I know the 8-bit place values: 128 64 32 16 8 4 2 1
■	I can convert denary to binary and binary to denary.
■	I can convert between binary and hexadecimal.
■	I know the two steps of Two's Complement — in order.
■	I can identify and explain overflow.
■	I know the difference between resolution and colour depth.
■	I know the difference between lossy and lossless compression.
■	I know the difference between sample rate and sample resolution.
■	I can calculate image and sound file sizes using the formulas.