



File Compression

IGCSE Computer Science Revision Sheet

■ **Big Idea:** File compression reduces the size of files so they use less storage space and can be transferred faster. There are two types: **lossless** (no data removed) and **lossy** (some data permanently removed).

Why Compression is Used

■ **Saves storage space.**

Smaller files mean more data fits on the same device — important for phones, SSDs, and servers.

■ **Speeds up file transfers.**

Smaller files travel faster across networks — critical for email attachments and uploads.

■ **Reduces download times.**

Compressed web assets (images, scripts) load faster, improving website performance.

■ **Enables streaming.**

Audio and video must be compressed so they stream smoothly without large bandwidth requirements.

EXAM TIP: Always explain WHY compression helps — smaller file = faster transfer = saves storage. Use "because" and "therefore".

Types of Compression

✓ LOSSLESS Compression

✗ LOSSY Compression





No data is removed.

- The original file can be **perfectly restored**.
- Compression is reversible.
- Smaller reduction in file size than lossy.
- Used where quality must be preserved.

Examples: ZIP, PNG, GIF

Best for: Documents, programs, text files

Some data is permanently removed.

- The original file **cannot be fully restored**.
- Compression is not reversible.
- Much greater reduction in file size.
- Small quality loss may be unnoticeable.

Examples: JPEG, MP3, MP4, AAC

Best for: Images, music, video streaming

KEY FACT: Lossless = no data lost, fully reversible. Lossy = data permanently removed, not reversible.

Teacher note: The most common exam error is saying lossless removes data. Emphasise: lossless finds smarter ways to store the same data — no information is lost.

Run Length Encoding (RLE) — Lossless in Action

RLE is a lossless compression technique that stores repeated values as a **value + count** pair instead of repeating each value individually.

Without RLE	With RLE	Saving
AAAABBBCCDDDDDD	4A 3B 2C 6D	15 → 8 values
WWWWWWWBBBWWWWW	7W 3B 5W	15 → 6 values

EXAM TIP: RLE works best with files that have many repeated values — e.g. simple images with large areas of one colour.

Teacher note: RLE is a Cambridge favourite. Give students a string of repeated characters and ask them to apply RLE — it makes the concept immediately concrete.

Lossless vs Lossy — Full Comparison





Feature	Lossless	Lossy
Data removed?	No — all data preserved	Yes — some data permanently lost
Reversible?	Yes — original fully restored	No — original cannot be recovered
File size reduction	Moderate	Much greater
Quality loss?	None	Some (may be unnoticeable)
Formats	ZIP, PNG, GIF, FLAC	JPEG, MP3, MP4, AAC
Best used for	Documents, programs, text	Images, music, video streaming

Teacher note: Cover the Lossless and Lossy columns and ask students to fill them in from memory. This table is the core of the topic and the basis of most comparison exam questions.





Quick Check Questions

1.	What is the difference between lossy and lossless compression?
2.	Give one example of a lossless file format.
3.	Give one example of a lossy file format.
4.	Explain why lossy compression is used for streaming video.
5.	What does RLE stand for and how does it work?
6.	Give two reasons why file compression is useful.

Answers on the next page →





Answer Guide

1.	Lossless compression reduces file size without removing any data — the original file can be perfectly restored. Lossy compression permanently removes some data to achieve a greater reduction in file size — the original cannot be recovered.
2.	Any one of: ZIP, PNG, GIF, FLAC.
3.	Any one of: JPEG, MP3, MP4, AAC.
4.	Lossy compression is used for streaming video because it reduces file size much more than lossless, therefore the video can be transmitted faster across the network and streamed without buffering. The quality loss is usually unnoticeable to viewers.
5.	RLE stands for Run Length Encoding. It works by storing sequences of repeated values as a single value plus a count — for example, AAAABBB is stored as 4A 3B — reducing the amount of data stored.
6.	Any two of: saves storage space; speeds up file transfers; reduces download times; enables efficient audio and video streaming.

■ **FutureLogic Summary:** Compression reduces file size to save storage and speed up transfers. Lossless = no data lost (ZIP, PNG) — fully reversible. Lossy = data permanently removed (JPEG, MP3) — not reversible. RLE is a lossless method that stores repeated values as value + count.

