Solutions

Each answer shows the steps, then the **result**.

2.1

- compression makes the file smaller
- any **one** of: **uses less storage** / **needs less bandwidth** / **shorter transmission time**

2.2

- 1 KiB = 2^{10} bytes
- **1024 bytes**

2.3

- a text file must be rebuilt **exactly** (losing one character changes the meaning)
- use **lossless** compression

2.4

- any **two** of: transmits faster / uses less bandwidth / takes less storage at the other end / a streamed file buffers less

2.5

- group identical neighbouring values: three b, two w, four b
- `3 b 2 w 4 b`

3.1 B

- **lossy** compression permanently removes data
- lossless and RLE keep the original; D is false

3.2

(a)

- every character must be kept exactly
- **lossless**

(b)

- five A's then three B's
- `5A 3B`

3.3

- large areas of one colour are **long runs** of the same value
- RLE stores each run as one count + one value, which **saves a lot of space**

3.4

(a)

- **lossy**: permanently removes data the user is unlikely to notice, so the original cannot be restored exactly
- **lossless**: keeps all the original data, so the file can be rebuilt exactly

(b)

- five w, three b, two w
- `5 w 3 b 2 w`

(c)

- original: 10 values × 4 bits = 40 bits
- compressed: 6 values × 4 bits = 24 bits
- saved: $40 - 24 = \mathbf{16}$ bits

(d)

- neighbouring pixels in a photograph are rarely identical, so the runs are very short
- each run still needs a count and a value, so the encoded file may be **no smaller, or even larger**

(e)

- any **two** of: frequencies people hear poorly are removed / quieter sounds masked by louder ones are dropped / sampling rate or resolution is reduced
- do **not** use lossy when the original quality must be kept, e.g. a **master recording** that will be edited further

(f)

- any **two** of: pages load faster / less storage on the server / less bandwidth, so costs are lower