

1.2 Text, sound and images

Name: _____ Class: _____ Date: _____

Total: 30 marks

KEY WORDS resolution 分辨率 • colour depth 颜色深度 • unicode 统一码
• sample resolution 采样分辨率 • sample rate 采样率

Objective

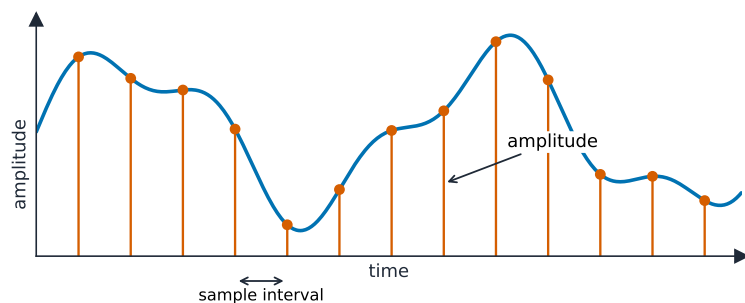
Build the skills to answer exam questions on **text, sound and images** 文本、声音与图像 — character sets, **sampling** 采样, pixels, and file-size calculations.

You must be able to:

- compare ASCII and Unicode
- define sample rate, sample resolution, resolution and colour depth
- calculate image and sound file sizes

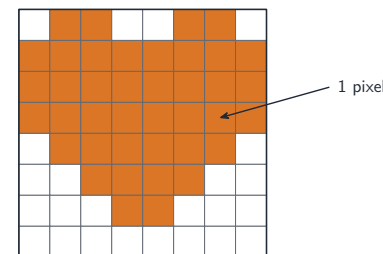
1 Worked examples

■ Sampling and pixels



$$\text{sample rate} = \text{samples/s} \quad \text{Nyquist} \geq 2f_{\text{max}}$$

Sampling records the wave's height (amplitude) at regular moments



resolution = 8×8 pixels

An image is a grid of pixels; resolution = number of pixels, colour depth = bits per pixel

- **image bits** = width $\times$ height $\times$ colour depth. **sound bits** = sample rate $\times$ resolution $\times$ seconds.

■ Text, sound and images: the same three questions

For every kind of data the exam asks the same things: how is it represented, what makes the file bigger, and what is the trade-off?

Text. Each character has a code. **ASCII** uses 7 bits, giving 128 characters, which is enough for English but not for other alphabets. **Unicode** 统一码 uses more bits per character (16 or more), so it covers every writing system, emoji included, but the same text takes more storage.

Sound. The wave is **sampled**: its amplitude is measured at regular intervals.

- **Sampling rate** 采样率 is the number of samples each second (in Hz or kHz). A higher rate follows the wave more closely, giving better quality and a larger file.
- **Sample resolution** 采样分辨率 (bit depth) is the number of bits used per sample. More bits record the amplitude more accurately, again improving quality and increasing the file size.

$$\text{file size (bits)} = \text{sampling rate} \times \text{sample resolution} \times \text{seconds} \times \text{channels}$$

Worked example. A 30-second mono recording is sampled at 44100 Hz with a resolution of 16 bits. Size = $44\,100 \times 16 \times 30 = 21\,168\,000$ bits = 2646000 bytes $\approx$ 2.6 MB. (Divide bits by 8 for bytes, then by 1024 for kibibytes, then by 1024 again for mebibytes.)

Images. A bitmap is a grid of **pixels** 像素.

- **Resolution** is the number of pixels, for example 1920×1080 .
- **Colour depth** 颜色深度 is the number of bits per pixel; n bits give 2^n colours, so 8 bits give 256 colours and 24 bits give over 16 million.

file size (bits) = width $\times$ height $\times$ colour depth

Worked example. An image of 800×600 pixels with a colour depth of 24 bits: $800 \times 600 \times 24 = 11\,520\,000$ bits = $1\,440\,000$ bytes ≈ 1.4 MB. Doubling the colour depth doubles the file size; doubling both width and height multiplies it by four.

2 Practice

2.1 State the difference between ASCII and Unicode. [2]

2.2 Define sample rate. [1]

2.3 Give one advantage and one disadvantage of Unicode compared with ASCII. [2]

2.4 Calculate the file size, in bytes, of a 10-second mono sound recording sampled at 8000 Hz with a resolution of 8 bits. [3]

2.5 State what happens to the file size of an image if its colour depth is increased from 8 bits to 16 bits. [1]

3 Exam-style questions

3.1 Increasing the colour depth of an image will: [1]

- | | |
|---|---|
| A | B |
| C | D |
- A reduce the file size
B increase the file size and quality
C have no effect
D reduce the resolution

3.2 An image is 200×100 pixels with a colour depth of 8 bits.

(a) Calculate the file size in bits. [2]

(b) Convert your answer to bytes. [1]

3.3 A sound is recorded for 20 seconds at a sample rate of 10 000 Hz with a sample resolution of 8 bits. Calculate the file size in bits. [2]

3.4 A student records a podcast and takes a photograph for its cover.

(a) Explain what is meant by sampling rate and by sample resolution. [2]

(b) The recording lasts 60 seconds, is mono, is sampled at 22 050 Hz and uses a resolution of 16 bits. Calculate the file size in mebibytes. [4]

(c) The student halves the sampling rate. State the effect on the file size and on the sound quality. [2]

(d) The cover photograph is 1200×900 pixels with a colour depth of 24 bits. Calculate its file size in mebibytes. [3]

(e) Explain why a colour depth of 24 bits allows over 16 million different colours. [2]

(f) The student's text file of show notes contains Chinese characters. Explain why it must use Unicode rather than ASCII. [2]