

1.2 Multimedia

Name: _____ Class: _____ Date: _____

Total: 41 marks**KEY WORDS** bitmap 位图 • pixel 像素 • resolution 分辨率 • file size 文件大小 • sampling 采样

Objective

Build the skills to answer exam questions on **multimedia** 多媒体 — how bitmap images and sound are stored, how to calculate their **file size** 文件大小, and when to use a bitmap or a vector graphic.

You must be able to:

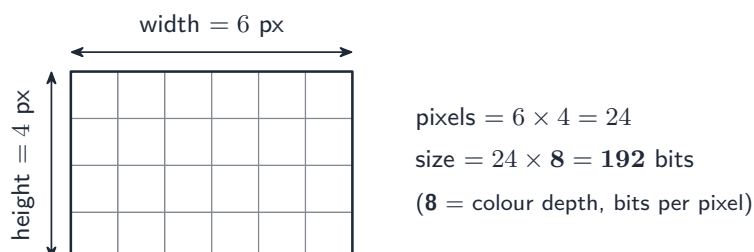
- describe how a **bitmap** 位图 image is encoded, and calculate its file size
- explain how **resolution** 分辨率 and **colour depth** 颜色深度 affect quality and size
- describe how a **vector graphic** 矢量图形 is encoded, and choose bitmap *or* vector for a task
- describe how sound is **sampled** 采样, and how the sampling rate and resolution affect quality and size

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Bitmap images and file size

A **bitmap** image stores the colour of every **pixel** 像素 in a grid. Two numbers describe it: the **resolution** (width × height in pixels) and the **colour depth** (bits per pixel). Multiply all three to get the size in bits.



$$\text{size (bits)} = \text{width} \times \text{height} \times \text{colour depth}$$

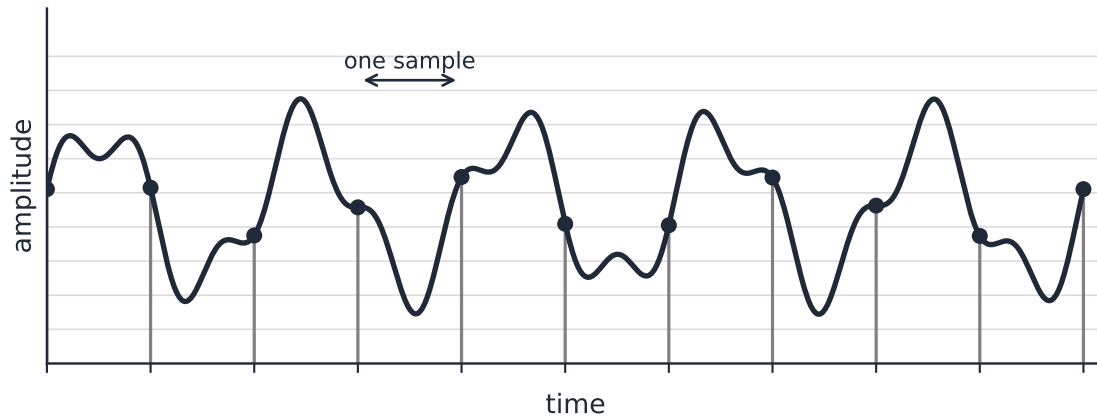
Then $\div 8$ for **bytes**, $\div 1024$ for **KiB**, $\div 1024$ again for **MiB**.

Example. A 200×150 image at 8 bits per pixel:

$$200 \times 150 \times 8 = 240\,000 \text{ bits} = 30\,000 \text{ bytes} = \frac{30\,000}{1024} \approx 29.3 \text{ KiB.}$$

■ Sound and file size

Sound is **sampled**: the wave's height (**amplitude** 振幅) is measured at regular time intervals. The **sampling rate** 采样率 is how many samples per second (Hz); the **resolution** is how many bits store each sample.



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

The faint horizontal lines are the amplitude levels — more bits of resolution means more levels and finer detail.

$$\text{size (bits)} = \text{sampling rate} \times \text{resolution} \times \text{duration} \times \text{channels}$$

Example. A 5-second **mono** (1 channel) clip at 8000 Hz, 16-bit resolution:

$$8000 \times 16 \times 5 \times 1 = 640\,000 \text{ bits} = 80\,000 \text{ bytes} \approx 78.1 \text{ KiB.}$$

■ Bitmap or vector?

A **vector graphic** stores the *instructions* to draw the image — geometric shapes (lines, curves, circles, polygons), each with attributes like position, size, colour and line width. The program draws (“renders”) them at whatever size is needed, so a vector **scales without losing quality**. It cannot, however, capture the detail of a photograph.

Task	Better choice	Why
Photograph	bitmap	per-pixel detail can't be described as shapes
Logo, icon, road sign	vector	sharp at any size; small file
Engineering drawing	vector	exact geometry, scales precisely

2 Practice

Now apply the methods above.

2.1 State what **colour depth** means, and write the formula for a bitmap's file size. [2]

2.2 Calculate the file size of a 1024×768 bitmap at 8 bits per pixel. Give your answer in **KiB**, showing your working. [3]

2.3 A 30-second **mono** sound clip is sampled at 16 kHz (16 000 Hz) with 8-bit resolution. Calculate its file size in **KiB**. [3]

2.4 Give one reason a **vector** graphic is a good choice for a company logo. [1]

3 Exam-style questions

3.1 A photo is 1920×1080 pixels with a colour depth of 24 bits.

(a) Calculate the file size in **MiB**. Show your working. [3]

(b) State **one** change to the image that would reduce its file size, and explain its effect on quality. [2]

3.2 A 3-minute song is recorded in **stereo** (2 channels), sampled at 44.1 kHz with 16-bit resolution.

(a) Calculate the file size in **MiB**. Show your working. [3]

(b) Explain the effect on the recording of **halving** the sampling rate. [2]

3.3 (a) State **two** pieces of data a vector graphic would store to describe a single circle. [2]

(b) A museum scans old paintings to put online. Justify whether a bitmap or a vector format is the better choice. [2]

3.4 Explain why a bitmap logo looks blocky when it is enlarged, but a vector logo stays sharp. [2]

3.5 A school records a 45-second announcement and also stores a scanned photograph of the school badge.

(a) The sound is sampled at 44.1 kHz with a sample resolution of 16 bits, in **stereo** (two channels). **Estimate** the file size in **mebibytes**, showing your working. [4]

(b) The recording is re-sampled at 22.05 kHz with an 8-bit resolution. **Describe** the effect on the file size and on the **accuracy** of the recording. [3]

(c) The badge is stored as a bitmap 600 pixels wide and 400 pixels high, using a colour depth of 24 bits. **Estimate** the file size in **kibibytes**. [3]

(d) **Explain** why the actual file on disk is **larger** than your answer to (c). [2]

(e) The badge uses only 6 distinct colours in large flat areas. **Explain** how **run-length encoding** would compress it, and **state** why it works far better on this image than on a photograph. [4]
