**Topic: Calculation of file size**

Reading Time: 20 mins

**·        Note\* Highlight important/core points while reading**

·        Read the content and write the answers given in the document in your words, to get the solid grip on topic.

**Calculation of File Size**

File size refers to the **amount of storage space** a file occupies on a storage device. The file size of an image, sound, or video depends on **resolution, bit depth, and compression**.

**1. Calculating Image File Size**

The size of an image file depends on:

* **Resolution**: The number of **pixels** in the image (Width × Height).
* **Color Depth**: The number of **bits per pixel** (bpp).

**Formula for Image File Size**

File Size (bits)=Image Width×Image Height×Color Depth

File Size (bytes) = Total Bits/8 ​

**Example 1: Storing a Photograph**

A photograph is **1024 × 1080 pixels** with a **color depth of 32 bits**. A memory stick has **64 GiB** storage. How many photographs of this size can fit?

**Step 1: Calculate total pixels**

1024×1080 = 1,105,920 pixels

**Step 2: Calculate file size in bytes**

1,105,920×32 = 35,389,440 bits

**Step 3: Convert memory stick size to bytes**

64 GiB = 64×1024×1024×1024 = 68,719,476,736 bytes

**Step 4: Calculate how many photos fit**

68,719,476,736 ÷ 4,423,680 = 15,534 photos

**Example 2: Storing an Image from a Camera Sensor**

A camera sensor has a **2048 × 2048 pixel array** with a **color depth of 16 bits**. Find the image size in **MiB**.

**Step 1: Calculate total pixels**

2048×2048 = 4,194,304 pixels

**Step 2: Calculate file size in bits**

4,194,304×16 = 67,108,864 bits

**Step 3: Convert to bytes**

67,108,864÷8 = 8,388,608 bytes

**Step 4: Convert bytes to MiB**

8,388,608 ÷ (1024×1024) = 8 MiB

Thus, **the image file size is 8 MiB**.

**2. Calculating Sound File Size**

For sound files, the file size depends on:

* **Sample Rate** (Hz) – how often the sound is recorded per second.
* **Bit Depth** – number of bits used to store each sample.
* **Number of Channels** – **Mono (1)** or **Stereo (2)**.
* **Duration** – length of the sound in seconds.

**Formula for Sound File Size**

File Size (bits)=Sample Rate×Bit Depth×Channels×Duration

File Size (bytes) = Total Bits/8​

**Example 3: Calculating the Size of a 10-second Stereo Sound Clip**

A stereo sound file is recorded at **44,100 Hz** with a **16-bit depth** for **10 seconds**.

**Step 1: Calculate total bits**

44,100×16×2×10 = 14,112,000 bits

**Step 2: Convert to bytes**

14,112,000 ÷ 8 = 1,764,000 bytes = 1.76 MB

**3. Video File Size Calculation**

The size of a video file depends on:

* **Frame Rate** – Number of frames per second (fps).
* **Resolution** – Number of pixels per frame.
* **Color Depth** – Number of bits per pixel.
* **Duration** – Length of the video in seconds.

**Formula for Video File Size**

File Size (bits)=Frame Rate×Resolution×Color Depth×Duration

File Size (bytes)=Total Bits/8

**A-Rated Questions/Answers By Examiner**

**Q1: Calculate the file size of a 5-second mono sound recording at 22,050 Hz with an 8-bit depth.**

**Answer:**

File Size = 22,050×8×1×5 = 882,000 bits

882,000÷8 = 110,250 bytes = 110.25 KB

**Q2: A 1920 × 1080 image uses a 24-bit color depth. Calculate its file size in MB.**

**Answer:**

Total Pixels = 1920×1080 = 2,073,600

Total Pixels = 1920×1080 = 2,073,600

Total Bits = 2,073,600×24 = 49,766,400

**Q3: A video is recorded at 30 fps with a resolution of 1280 × 720 pixels, using 24-bit color depth. If the video lasts 10 seconds, calculate the file size in MB.**

**Answer:**

Total Frames = 30×10 = 300

Total Pixels per Frame = 1280×720 = 921,600

Total Bits = 921,600×24×300 = 6,635,520,000

Total Bytes = 6,635,520,000÷8 = 829,440,000 bytes = 829.44 MB

**Q4: What factors affect the size of a sound file?**

**Answer:**

1. **Sample Rate** – Higher Hz = larger file.
2. **Bit Depth** – More bits = better quality but larger file.
3. **Channels** – Stereo uses twice the storage of mono.
4. **Duration** – Longer recordings need more space.

**Q5: Why does a compressed file take up less space?**

**Answer:**  
Compressed files use **algorithms** to remove **redundant data**, making the file **smaller** while keeping important information. Examples:

* **JPEG** for images.
* **MP3** for sound.
* **MP4** for video.

### Write your Answers on your Notebook and Verify it on Next Screen

**Q6: How much storage space is required for a 5-minute uncompressed stereo audio file recorded at 48,000 Hz with a 24-bit depth?**

**Q7: An uncompressed video has a resolution of 1920 × 1080 pixels, a frame rate of 60 fps, and a color depth of 30 bits. If the video lasts 2 minutes, calculate its file size in GB.**

**Q8: How does increasing color depth affect an image’s file size?**

**Q9: How many frames are in a 3-minute video recorded at 24 fps?**

**Q10: A 4-minute MP3 file is 5 MB, while a 4-minute WAV file is 40 MB. Why is the MP3 file smaller?**

**6. Answer:**

* **Formula:**  
  **File Size (bits) = Sample Rate × Bit Depth × Channels × Duration**  
  **= 48,000 × 24 × 2 × (5 × 60)**  
  **= 48,000 × 24 × 2 × 300**  
  **= 691,200,000 bits**
  + Convert to bytes: **691,200,000 ÷ 8 = 86,400,000 bytes**
  + Convert to MB: **86,400,000 ÷ 1,024 ÷ 1,024 ≈ 82.4 MB**

**Answer:** **A 5-minute uncompressed stereo audio file at 48,000 Hz, 24-bit depth requires approximately 82.4 MB of storage.**

**7. Answer:**

* **Formula:**  
  **File Size (bits) = Frame Rate × Resolution × Color Depth × Duration**  
  **= 60 × (1920 × 1080) × 30 × (2 × 60)**  
  **= 60 × 2,073,600 × 30 × 120**  
  **= 448,569,600,000 bits**
  + Convert to bytes: **448,569,600,000 ÷ 8 = 56,071,200,000 bytes**
  + Convert to GB: **56,071,200,000 ÷ 1,024 ÷ 1,024 ÷ 1,024 ≈ 52.2 GB**

**Answer:** **A 2-minute uncompressed 1080p, 60 fps, 30-bit video requires approximately 52.2 GB of storage.**

**8. Answer:**

* **More bits per pixel** → More possible colors → **Larger file size**
* Example:
  + **8-bit image (256 colors)** → **1 MB**
  + **24-bit image (True Color, 16.7 million colors)** → **3 MB**
  + **32-bit image (with transparency)** → **4 MB**

**Answer:** **Higher color depth increases file size because each pixel requires more storage.**

**9. Answer:**

* **Formula:**  
  **Total Frames = Frame Rate × Duration**  
  **= 24 × (3 × 60)**  
  **= 24 × 180**  
  **= 4,320 frames**

**Answer:** **A 3-minute video at 24 fps contains 4,320 frames.**

**10. Answer:**

* **MP3 uses lossy compression**, removing unnecessary sounds to reduce size.
* **WAV is uncompressed**, keeping all original sound data.
* **Bit rate difference**: MP3 may use **128–320 kbps**, while WAV uses **1,411 kbps**.

**Answer:** **MP3 files are smaller due to lossy compression, which removes redundant audio data, unlike uncompressed WAV files.**