# S5 Information and Communication Technology Practice Paper: Binary and Hexadecimal Conversion, Two's Complement, SQL and Normalisation, Multimedia File Sizes, CPU Execution Time, Algorithm Tracing, Bubble Sort, Binary Search, IPv4 Subnetting, Bandwidth and Compression, Information Security (100 marks)

Level: S5 | Subject: Information and Communication Technology | 75 minutes | 100 marks | 24 questions | question paper

## Part 1 Number Systems and Data Representation (16 marks)

**Show all conversion and calculation steps.**

| # | Question | Marks |
|---|---|---|
| 1 | Convert 11010110 binary to denary and hexadecimal, and write out the place value expansion. | 4 |
| 2 | Convert 3A9F hexadecimal to denary and to 16-bit binary. | 4 |
| 3 | Represent -46 in 8-bit two's complement and explain the meaning of the most significant bit. | 4 |
| 4 | A passage has 500 Chinese characters and 300 ASCII characters stored in UTF-8. Compute the number of bytes and bits. | 4 |

## Part 2 Data Organisation, Databases and SQL (16 marks)

**Write complete executable SQL statements (upper case keywords are accepted).**

| # | Question | Marks |
|---|---|---|
| 5 | Explain the relationship between a primary key and a candidate key, with one example. | 4 |
| 6 | The table Student(SID, Name, Class) exists. Write an SQL statement listing the names of class 5A students in ascending name order. | 4 |
| 7 | One column stores two phone numbers "9123 4567, 9876 5432". State which normal form is violated and how to fix it. | 4 |
| 8 | Table Orders has 240 rows: 96 with Amount >= 500, 150 with Status = 'PAID' and 60 satisfying both; table Customers has 12 rows. Write the SQL counting rows with Amount >= 500 and paid, and compute the Cartesian product size. | 4 |

## Part 3 Computer Systems and Multimedia File Sizes (17 marks)

**Unless stated otherwise, 1 MiB = 1,048,576 bytes and 1 MB = 1,000,000 bytes.**

| # | Question | Marks |
|---|---|---|
| 9 | A 4000 by 3000 pixel bitmap uses 24-bit colour and is uncompressed. Compute its size in bytes and MiB (1 MiB = 1,048,576 bytes). | 4 |
| 10 | A 180-second stereo recording uses a 44,100 Hz sampling rate and 16-bit samples with no compression. Compute its size in bytes and MiB. | 4 |
| 11 | A 2-minute video has a bit rate of 4 Mbps. Compute its size in MB and MiB. | 4 |

| | | |
|---|---|---|
| 12 | A CPU runs at 3.2 GHz with an average CPI of 2.5 and executes 8*10^9 instructions. Compute the number of clock cycles and the execution time. | 5 |

## Part 4 Programming and Algorithms (17 marks)

**Show the value of every variable in each iteration.**

| # | Question | Marks |
|---|---|---|
| 13 | Trace the pseudocode and give the output and the value of total after each iteration. total <- 0 FOR i <- 1 TO 5 total <- total + i*i NEXT i OUTPUT total | 4 |
| 14 | Using binary search on 1,000 sorted records, what is the maximum number of comparisons? Show the derivation. | 4 |
| 15 | Perform the first pass of bubble sort (ascending, comparing adjacent pairs left to right) on [45, 12, 78, 33, 9]. Give the list after the first pass. | 4 |
| 16 | One algorithm is O(n log2 n) and another is O(n^2). For n = 1,024, compute the operations of each and the ratio. | 5 |

## Part 5 Networks, the Internet and Subnetting (17 marks)

**State the formula and the unit used.**

| # | Question | Marks |
|---|---|---|
| 17 | A network uses a /26 subnet mask. Compute the addresses per subnet, the usable hosts per subnet and the dotted decimal mask. | 4 |
| 18 | A 45 MiB file is sent over a 12 Mbps link. Compute the time needed in seconds. | 4 |
| 19 | A 24 MiB file compresses to 7.5 MiB. Compute the compression ratio and the percentage saved. | 4 |
| 20 | A web page is 1.5 MiB in total, the link runs at 20 Mbps and the round trip time is 60 ms. Compute the total download time assuming no other delay. | 5 |

## Part 6 Information Systems, Compression and Security (17 marks)

**Answer security and literacy questions with reference to Hong Kong law.**

| # | Question | Marks |
|---|---|---|
| 21 | A 15-minute 1080p video has a bit rate of 8 Mbps. Compute its size in MB and GiB (1 GiB = 1,024 MiB). | 4 |
| 22 | Compare symmetric and asymmetric encryption and explain how a digital signature gives both authentication and integrity. | 4 |
| 23 | An employee uploads customer HKID numbers and medical records to an unencrypted public cloud. Name the Hong Kong ordinance likely breached and three improvements. | 4 |
| 24 | A 250 GiB backup set compresses to 40 per cent of its original size and is copied to a 4 TB (4,000 GB) disk. Compute the compressed size and how many full backups fit. | 5 |