# S5 ICT Practice Paper (Set 4): Relational Databases and SQL Queries, IPv4 Subnetting, Python Code Tracing, Sorting and Searching Complexity, Image and Video File Size with Compression, Information Security

S5 Information and Communication Technology | 100 marks | 75 minutes

## Question 1 — Relational Databases and SQL (17 marks)

*The table below shows two relations of a school database. Scores(student_id, name, class, score); Clubs(student_id, club, joined_year). Answer all parts in SQL.*

Write an SQL statement that lists the name and score of the top three students in class 5A, highest score first. *(4 marks)*

Write an SQL statement listing every student name with the average score, showing only students whose average score is at least 60. *(4 marks)*

Scores holds 2,000 records of 320 bytes each with a data page size of 4,096 bytes. Find the total size in bytes and the minimum number of data pages, showing working. *(4 marks)*

The Clubs table originally stored student name, class and club in one table, causing duplication and update anomalies. Describe briefly how to normalise it into two related tables and give one benefit. *(5 marks)*

## Question 2 — IPv4 Subnetting (17 marks)

*A school is allocated the network 192.168.10.0/24 and must divide it into four equal subnets, one for each department.*

State the new prefix length and the subnet mask in dotted decimal notation. *(4 marks)*

Find the total number of addresses and the number of usable hosts per subnet, showing working. *(4 marks)*

Give the network address, the first and last usable host addresses, and the broadcast address of the third subnet. *(5 marks)*

If one department later needs only 20 hosts, is it workable to borrow further host bits to split again? State one consideration. *(4 marks)*

## Question 3 — Python Code Tracing (16 marks)

*Study the program below and answer each part with the exact output. nums = [2, 5, 8, 11, 13] acc = {} for n in nums: acc[n % 3] = acc.get(n % 3, 0) + n print(acc) print(sum(nums))*

State the output of print(acc). *(4 marks)*

State the output of print(sum(nums)). *(4 marks)*

Explain the role of the second argument 0 in acc.get(n % 3, 0). *(4 marks)*

If nums becomes [1, 4, 7], state the new output of print(acc). *(4 marks)*

## Question 4 — Comparison Counts in Sorting and Searching (17 marks)

*A sorted array holds 1,024 integers. Show working in every part.*

How many comparisons does bubble sort need in the worst case for 6 elements? Write the formula. *(5 marks)*

Using binary search on 1,024 elements, what is the maximum number of comparisons in the worst case? Explain. *(4 marks)*

If linear search is used instead, how many comparisons are needed in the worst case, and by what factor does it exceed binary search? *(4 marks)*

Merge sort needs about 1,024 x log2(1,024) comparisons for 1,024 elements. Compute it and state why its time complexity is better than bubble sort. *(4 marks)*

## Question 5 — Image and Video File Size and Compression (16 marks)

*A 24-bit RGB image has a resolution of 1920 x 1080. A video is recorded at 30 frames per second with 1.0 MB per frame for 90 seconds and sent over a 100 Mbps link.*

Find the uncompressed size of the image in bytes and in MiB (2 decimal places). *(4 marks)*

If lossy compression keeps only 40% of the original size, find the compressed size in bytes and MiB. *(4 marks)*

Find the total size of the video in MB. *(4 marks)*

Find the time needed to send the video over 100 Mbps, in seconds and in minutes and seconds. *(4 marks)*

## Question 6 — Password Space and Information Security (17 marks)

*A system requires an 8-character password using lowercase letters only. Assume an attacker can try 1,000,000 passwords per second.*

Find the total number of possible passwords using the 26 lowercase letters. *(4 marks)*

If the 10 digits are also allowed, give the new total (exponential form accepted). *(4 marks)*

At 1,000,000 tries per second, how many days are needed to exhaust 26^8 passwords (2 decimal places)? *(4 marks)*

The system should store passwords as salted hashes rather than symmetric ciphertext. Explain the security purpose of each of the two measures. *(5 marks)*