S5 ICT Practice Paper: Computer Systems and Data Representation, Programming and Algorithms, Databases and SQL, Computer Networks and the Internet, Multimedia and Data Compression, Information Systems and Security

S5 | Information and Communication Technology | Time: 75 minutes | Total: 100 marks | 24 questions

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Part 1: Computer Systems and Data Representation

Show your working; use 1 GB = 1 024 MB for capacity conversions.

1. Convert the binary number 11010110 into denary and give its hexadecimal form. [5]

Answer: Add the place values 128 + 64 + 16 + 4 + 2 = 214; grouping into nibbles 1101 and 0110 gives D and 6, so the answer is D6.

2. A photograph takes about 4 MB. How many such photographs fit on a 5 GB card? [5]

Answer: 5 x 1 024 = 5 120 MB, and 5 120 / 4 = 1280 photographs.

3. How many colours can 8-bit and 24-bit colour depth represent? How many times more is the latter than the former? [5]

Answer: 8 bits give 2^8 = 256 colours and 24 bits give 2^24 = 16777216 colours, i.e. 65536 times more.

4. An uncompressed stereo recording is sampled at 44 100 Hz with 16-bit depth for 60 seconds. What is its approximate size in MB? [5]

Answer: 44 100 x 16 x 2 x 60 / 8 = 10584000 bytes, which is about 10.09 MB.

Part 2: Programming and Algorithms

Pseudocode or a variable trace table is acceptable; state the final output.

5. total <- 0; for i <- 1 to 10 do total <- total + i. What is total at the end? [4]

Answer: Summing 1 to 10 gives 10 x 11 / 2 = 55.

6. total <- 0; for i <- 1 to 5 do total <- total + i * i. What is total at the end? [4]

Answer: The sum of squares 1 + 4 + 9 + 16 + 25 = 55.

7. A binary search runs on the sorted integers 1 to 1 000. What is the maximum number of comparisons needed? [5]

Answer: Each comparison halves the range; since 2^10 = 1 024 is at least 1 001, at most 10 comparisons are needed.

8. Bubble sort is applied to 6 items stored in exactly reverse order. How many passes are needed? [5]

Answer: Each pass fixes one item, so n - 1 = 5 passes are enough.

Part 3: Databases and SQL

Give the value or the SQL statement only; no syntax explanation is required.

9. A table holds 5 000 records but only 4 800 distinct student numbers. If the student number is the primary key, how many records are duplicates? [4]

Answer: 5 000 - 4 800 = 200 records; a primary key must be unique so they must be cleaned first.

10. The score column holds 45, 58, 60, 72, 88 and 59. What does SELECT COUNT(*) FROM students WHERE score >= 60 return? [4]

Answer: The values 60, 72 and 88 satisfy the condition (>= includes 60), so the result is 3.

11. Table A has 4 rows and table B has 5 rows joined on an equality condition. Exactly 12 pairs match, how many rows does the result hold? [4]

Answer: Every matching pair produces one row, so the result has 12 rows, never more than 4 x 5 = 20.

12. An unnormalised table stores the marks of 6 students in 3 subjects inside one row. After splitting into a student table and a subject table, how many rows are there? [4]

Answer: The student table holds 6 rows and the subject table 3, giving 9 rows with no repeating group.

Part 4: Computer Networks and the Internet

Give transmission times in seconds to two decimal places.

13. A subnet uses a /26 mask. How many usable host addresses does each subnet provide? [4]

Answer: There are 32 - 26 = 6 host bits, so 2^6 - 2 = 62 usable addresses after removing the network and broadcast addresses.

14. A 5 MB file is sent over a 10 Mbps link. Ignoring overhead, what is the minimum time in seconds? [4]

Answer: 5 x 1 024 x 1 024 x 8 = 41 943 040 bits, and dividing by 10 000 000 gives about 4.19 seconds.

15. State the default port numbers for HTTP, HTTPS, SMTP and DNS. [4]

Answer: HTTP 80, HTTPS 443, SMTP 25 and DNS 53; HTTPS runs over TLS, so it does not share the HTTP port.

16. Four computers are wired as a full mesh. How many cables are needed? How many if they are instead connected to one central switch? [4]

Answer: A full mesh needs n(n - 1) / 2 = 6 cables, while a star topology needs only 4 and isolates faults better.

Part 5: Multimedia and Data Compression

Give sizes in MB to two decimal places and state whether the data is compressed.

17. A 1 920 x 1 080 image at 24-bit true colour: what is its uncompressed size in bytes and in MB? [4]

Answer: 1 920 x 1 080 x 3 = 6220800 bytes, which is about 5.93 MB.

18. The same image compresses to 622080 bytes. What is the compression ratio and the saving in per cent? [4]

Answer: The ratio is 10 : 1, so the file is one tenth of its original size and 90% is saved.

19. A 44 100 Hz 16-bit stereo recording lasts 180 seconds. Give its uncompressed size in bytes and in MB. [4]

Answer: 44 100 x 16 x 2 x 180 / 8 = 31752000 bytes, about 30.28 MB; lossy compression shrinks it considerably.

20. A video encoded at 8 Mbps runs for 120 seconds. What is its approximate size in MB? [4]

Answer: 8 x 120 = 960 Mb, and dividing by 8 gives 120 MB.

Part 6: Information Systems, Security and Society

Short answers are acceptable; show the formula where a calculation is involved.

21. Of 250 000 accounts on a site, 10 000 are leaked. What percentage is that? [4]

Answer: 10 000 / 250 000 x 100% = 4%.

22. How many 4-digit PIN combinations exist? If only 3 attempts are allowed, what is the maximum chance of a random guess succeeding? [4]

Answer: Each digit has 10 choices, so there are 10^4 = 10000 combinations; 3 attempts give at most about 0.0300%.

23. Explain the 3-2-1 backup rule and state which risk it addresses. [3]

Answer: Keep at least 3 copies on 2 different media with 1 copy off-site; it guards against ransomware or hardware failure destroying every copy at once.

24. An organisation receives 500 emails, 75 of which are phishing. What percentage is that, and which single control is most effective? [3]

Answer: 75 / 500 x 100% = 75%; staff training combined with mail filtering is most effective, since filtering alone cannot stop every message.
