S4 Information and Communication Technology Practice Paper: Data Representation and Binary, Computer Systems and Storage, Networks and the Internet, Databases and Spreadsheets, Programming and Algorithms, Information Literacy and Security

S4 | Information and Communication Technology | Time: 75 minutes | Total: 100 marks | 24 questions

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Part A - Data Representation and Binary (20 marks)

Show your working. State the number of bits in every binary answer.

1. Convert the binary number 10110110 to denary. [5]

Answer: 10110110 = 128 + 32 + 16 + 4 + 2 = 182.

2. Convert the denary number 202 to an 8-bit binary number. [5]

Answer: 202 = 128 + 64 + 8 + 2, so the answer is 11001010.

3. An uncompressed 24-bit colour image is 1024 x 768 pixels. Find its file size in MiB, where 1 MiB = 1024 x 1024 bytes. [5]

Answer: Pixels = 1024 x 768 = 786,432; each pixel uses 24 bits = 3 bytes; total 2,359,296 bytes = 2.25 MiB.

4. Find the denary value of the hexadecimal number 3F and convert denary 201 to hexadecimal. [5]

Answer: 3F = 3 x 16 + 15 = 63; 201 = 12 x 16 + 9, so 201 = C9.

Part B - Computer Systems and Storage (18 marks)

Show steps in calculations; in comparison questions state two differences.

5. A hard disk is labelled 2 TB, where the maker uses 1 TB = 10^12 bytes and the operating system uses 1 TiB = 1024^4 bytes. Find the capacity shown by the system in TiB, correct to 2 decimal places. [5]

Answer: 2 x 10^12 / 1,099,511,627,776 = 1.82 TiB approximately.

6. Compare SSD and HDD in terms of access speed and resistance to shock. [5]

Answer: An SSD has no moving parts, so random access is faster and it withstands shock better; an HDD uses a head over spinning platters, so access is slower and it is easily damaged by shock.

7. A program needs 8 GB of memory but the computer has only 6 GB of physical RAM. If the operating system uses virtual memory, find the paging space needed on disk in GB. [4]

Answer: Paging space = 8 - 6 = 2 GB.

8. A processor runs at 3.2 GHz and needs 4 clock cycles per instruction on average. Find the number of instructions executed per second in millions. [4]

Answer: Cycles per second = 3.2 x 10^9; instructions = 3.2 x 10^9 / 4 = 8 x 10^8 = 800 million.

Part C - Networks and the Internet (16 marks)

Use 1 byte = 8 bits and 1 Mb = 10^6 bits.

9. A 480 MB file is downloaded over a 100 Mbps connection. Find the time needed in seconds. [4]

Answer: File = 480 x 8 = 3,840 Mb; time = 3,840 / 100 = 38.4 seconds.

10. An IPv4 network uses a /24 prefix length. Find the number of host addresses available in that subnet. [4]

Answer: Host bits = 32 - 24 = 8; usable hosts = 2^8 - 2 = 254 after removing the network and broadcast addresses.

11. Match each protocol to its use: HTTP, HTTPS, SMTP, FTP. [4]

Answer: HTTP transfers web pages; HTTPS transfers web pages with encryption; SMTP sends email; FTP transfers files.

12. Compare 2.4 GHz and 5 GHz wireless networks in terms of coverage and interference. [4]

Answer: 2.4 GHz has a longer wavelength, penetrates walls better and covers more area, but shares the band with many devices so interference is higher; 5 GHz is faster with less interference but covers less area.

Part D - Databases and Spreadsheets (16 marks)

Spreadsheet questions use A1 style cell references.

13. Cells B2 to B6 hold 68, 72, 55, 80 and 90. Find the results of =SUM(B2:B6) and =AVERAGE(B2:B6). [4]

Answer: Sum = 365; average = 365 / 5 = 73.

14. Explain the purpose of a primary key in a database and give one example. [4]

Answer: A primary key uniquely identifies each record and cannot be duplicated or left empty, for example the student ID in a student table.

15. A student table has 200 records: 120 students take ICT and 45 students take ICT with a mathematics score of 80 or above. A query requires ICT AND mathematics >= 80. Find the number of matching records. [4]

Answer: 45 records match, because the two conditions are combined with AND, not added.

16. State the difference between sorting and filtering in a spreadsheet. [4]

Answer: Sorting changes the display order without hiding records; filtering shows only records that meet a condition and hides the rest.

Part E - Programming and Algorithms (15 marks)

Pseudo-code or formulas are both acceptable; show your steps.

17. Write an algorithm that finds the sum of the integers from 1 to 50 and state the result. [4]

Answer: sum <- 0; for i from 1 to 50 do sum <- sum + i; result = 50 x 51 / 2 = 1,275.

18. A binary search looks for a target in 1,000 sorted items. Find the maximum number of comparisons needed. [4]

Answer: Each comparison halves the range; since 2^10 = 1024 >= 1000, at most 10 comparisons are needed.

19. Bubble sort is applied to 5 items. Find the number of comparisons in the worst case. [4]

Answer: Comparisons = n(n - 1) / 2 = 5 x 4 / 2 = 10.

20. What is the value of x after this pseudo-code? x <- 3; repeat 4 times: x <- x * 2. [3]

Answer: Each pass doubles x, so after 4 passes x = 3 x 2^4 = 48.

Part F - Information Literacy and Security (15 marks)

In explanation questions give a concrete measure or reason.

21. How many different 4-digit PIN codes are possible? [4]

Answer: Each digit has 10 choices, so there are 10^4 = 10,000 combinations.

22. An 8-character password uses upper case letters, lower case letters and digits, giving 62 possible characters. Find the number of combinations in scientific notation to 3 significant figures. [4]

Answer: Combinations = 62^8 = 2.18 x 10^14.

23. Explain how a phishing email works and suggest one preventive measure. [4]

Answer: A phishing email pretends to come from a trusted organisation and tricks the receiver into clicking a link or entering a password; measures include checking the sender domain, not clicking suspicious links and enabling two-factor authentication.

24. Describe the 3-2-1 backup rule. [3]

Answer: Keep 3 copies of the data, on 2 different types of media, with 1 copy stored off site.
