S3 ICT Practice Paper (Set 2): number systems, logic gates, networks, spreadsheets, databases and algorithms

S3 Information and Communication Technology | Time: 60 minutes | Total: 100 marks | 22 questions

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Section A: Number systems and data representation (16 marks)

Use the information above to answer Section A.

1. (a) Convert the binary number 1011 0110 into decimal and into hexadecimal, showing your working.

1011 0110 = 128 + 32 + 16 + 4 + 2 = 182. 182 divided by 16 is 11 remainder 6, so the hexadecimal value is B6.

2. (b) Convert the decimal number 245 into an 8-bit binary number and give its hexadecimal value.

245 = 128 + 64 + 32 + 16 + 4 + 1 = 1111 0101. 1111 is F and 0101 is 5, so the hexadecimal value is F5.

3. (c) Calculate the size of File 1 (12 seconds, stereo, 44 100 Hz, 16 bits) in MB, taking 1 MB as 1 048 576 bytes, and explain why a music file is usually smaller than this value.

Bytes per second = 44 100 x 2 x 2 = 176 400; for 12 seconds the size is 2 116 800 bytes, and 2 116 800 divided by 1 048 576 is about 2.02 MB. Music files are usually compressed, for example to MP3, by discarding sounds the ear hardly notices, so they are smaller than this uncompressed value.

4. (d) Give the ASCII decimal values and the 8-bit binary codes of the three letters in File 2.

I is 73 (0100 1001), C is 67 (0100 0011) and T is 84 (0101 0100). The three characters take 3 x 8 = 24 bits.

Section B: Logic gates (16 marks)

Use the alarm system above to answer Section B.

5. (a) Complete the truth table: give the value of B for (D, W, O) equal to (0,0,0), (1,0,0), (0,1,1) and (1,1,0).

For (0,0,0), D OR W is 0 and NOT O is 1, so B is 0. For (1,0,0), B is 1. For (0,1,1), D OR W is 1 but NOT O is 0, so B is 0. For (1,1,0), B is 1.

6. (b) Explain why the buzzer stays silent when the caretaker turns on the override key even if both door and window sensors detect movement.

NOT O becomes 0, and anything AND 0 is 0, so B is 0. The override key lets the caretaker silence the alarm during maintenance or testing.

7. (c) Draw, or describe in words, a gate circuit that produces B, and state the number and type of logic gates used.

Use one OR gate with inputs D and W, one NOT gate with input O, then one AND gate taking those two outputs. Three gates are used: one OR, one NOT and one AND.

8. (d) If the circuit were changed to B = (D AND W) OR (NOT O), what would the buzzer do when the override key is on, and what is the problem with that design?

When the override is on, NOT O is 1, so the OR gate always outputs 1 and the buzzer sounds continuously. The override would no longer work, which is unacceptable during maintenance.

Section C: Networks, bandwidth and security (16 marks)

Use the school network above to answer Section C.

9. (a) Name the type of network formed by the 30 computers, the printer and the file server, give one reason, and give one example of a wide area network (WAN).

It is a local area network (LAN) because all devices are inside one building and managed by the school. A WAN example is the Internet, or a bank network linking branches in different districts.

10. (b) How many seconds are needed at least to download the 480 MB video over the 40 Mbps link? Show your working.

480 MB is 480 x 8 = 3 840 Mb, and 3 840 divided by 40 is 96 seconds, which is 1 minute 36 seconds.

11. (c) Which service normally assigns IP addresses to the school computers? Give one private IP address range and explain why private addresses are used inside the school.

A DHCP server, usually built into the router, assigns them automatically. One private range is 192.168.0.0 to 192.168.255.255. Private addresses save public IPv4 addresses and let the router hide internal hosts with NAT, which improves security.

12. (d) When a student types a password into Internet banking, which protocol should the web address start with? Explain how it differs in security from the unencrypted protocol.

It should start with HTTPS, which uses port 443 by default. HTTPS encrypts traffic with TLS, so an intercepted password cannot be read, and it also proves the server identity. HTTP sends plain text, so a man in the middle can read the password directly.

Section D: Spreadsheet modelling (16 marks)

Use the spreadsheet above to answer Section D.

13. (a) The formula in E2 is copied to E5. Write the formula in E5 and explain the difference between C1 and B2 in the copied formula.

The formula in E5 is =IF(B5 is greater than or equal to C1, "Pass", "Fail"). B2 is a relative reference and changes to B5 when copied, while C1 is an absolute reference that stays C1, so every row is compared with the same pass mark.

14. (b) If the value in B3 is 58, what will E3 display? Show your reasoning.

58 is less than the pass mark 60, so the condition is false and E3 displays "Fail".

15. (c) Write the formulas that calculate the class average mark and the number of students who borrowed 4 books or more.

Average mark: =AVERAGE(B2:B31). Students with 4 books or more: =COUNTIF(D2:D31, "greater than or equal to 4"), or =COUNTIF(D2:D31, ">=4").

16. (d) To compare the number of students in the mark bands 0-59, 60-69, 70-79 and 80 or above, which chart should the teacher use? Give one reason.

A column chart is best because it compares counts of separate categories at a glance, while a pie chart only shows each part as a share of the whole.

Section E: Databases and algorithms (16 marks)

Use the table and pseudocode above to answer Section E.

17. (a) Name three fields of this table and state which field is the best primary key, with a reason.

The fields are StudentID, Class, Books and Fine. StudentID is the best primary key because each student has one unique ID that never repeats.

18. (b) Write a query condition that finds 3A students who borrowed 4 books or more, and state how many records match.

The condition is Class = "3A" AND Books greater than or equal to 4. The matching records are S01 (5 books) and S04 (4 books), so 2 records match.

19. (c) Trace the pseudocode and give the value of total after each loop and the final output.

After i equal to 1, 2, 3, 4 and 5 the totals are 3, 9, 18, 30 and 45. The final output is 45.

20. (d) To sum the squares of 1 to 5 instead, which line must change, what should it become, and what is the new output?

Change total = total + i * 3 to total = total + i * i and leave the other lines unchanged. The new output is 1 + 4 + 9 + 16 + 25 = 55.

Section F: Integrated data analysis and security advice (20 marks)

Use the e-library log above to answer Section F.

21. (a) Work out the weekly totals of logins and books borrowed, the average books borrowed per day to one decimal place, and the busiest day. Then compare with storage: if 4 500 MB of e-books uses 90 percent of the capacity, what is the total capacity in MB and how much free space is left?

Logins total 120 + 96 + 138 + 84 + 162 = 600. Books borrowed total 86 + 61 + 104 + 52 + 121 = 424, so the daily average is 424 divided by 5, which is 84.8 books. Friday is busiest with 162 logins. Capacity: 4 500 divided by 0.9 is 5 000 MB, leaving 5 000 minus 4 500 = 500 MB, which matches the log.

22. (b) Overdue items rise from 9 on Monday to 14 on Friday. Suggest two concrete improvements, one about reminders and one about fines or loan periods, each with a reason, and suggest one way to protect students personal data in the library system.

Send an automatic email or app reminder two days before the due date, because most overdue items are forgotten rather than kept on purpose. Shorten the loan period from 14 to 10 days, or suspend borrowing after an overdue item, because shorter loans keep books moving. To protect personal data, allow only the librarian account to view individual borrowing records, show other users aggregated statistics only, and change passwords regularly.

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