S6 ICT Practice Paper: Networks and Data Transmission, Encryption and Security, Databases and SQL, Algorithms and Programming, System Development and Testing, Ethics and Sustainable Computing

S6 | Information and Communication Technology | Time: 75 minutes | Total: 100 marks | 24 questions

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Section A Networks and Data Transmission

Part A: 4 marks each, 16 marks in total.

1. A 480 MB file is sent over a link rated at 100 Mbps, but the effective throughput is only 80% of the rated value. Calculate the time required in seconds. [4]

2. An uncompressed bitmap is 3000 x 2000 pixels with 24 bits per pixel. Find its size in MB. If lossless compression reduces the size by 70%, find the compressed size in MB. [4]

3. An IPv4 network uses a /26 prefix. State the number of usable hosts, the subnet mask in dotted decimal, and the broadcast address for 192.168.10.64/26. [4]

4. A 60 MB file is transferred over a 50 Mbps link with a round-trip time of 40 ms, and two round trips are needed for the handshake. Ignoring other delays, find the total time in seconds. [4]

Section B Encryption and Network Security

Part B: 4 marks each, 16 marks in total.

5. Compare symmetric and asymmetric encryption in key distribution: for 10 users communicating pairwise, how many keys does each scheme need? Give one performance advantage and one disadvantage of each. [4]

6. RSA uses primes p = 61, q = 53 and public exponent e = 17. Find n, $\phi(n)$ and the private key d, then encrypt and decrypt the plaintext m = 65. [4]

7. A system uses passwords of exactly 8 characters drawn from upper case, lower case and digits (62 symbols). Find the total number of combinations, and the average time to crack it in days (one decimal place) if an attacker tries 10^9 combinations per second. [4]

8. A company has 500 staff and 3% of them clicked a fake link in a phishing test. Calculate the number who clicked and explain what a firewall and staff training each defend against. [4]

Section C Databases and SQL

Part C: 4 marks each, 16 marks in total.

9. Explain the purpose of a primary key, a foreign key and normalisation, and why an unnormalised table causes update anomalies. [4]

10. Table Marks holds 5 scores: 72, 58, 91, 45, 84. Write the SQL for the average score and state the result. [4]

11. Given Student(student_id, name) and Enrol(student_id, class_code), write SQL that lists the number of students per class, showing only classes with more than 20 students, sorted from the largest group down. [4]

12. A table has 1,000,000 records; a full scan costs about 10 microseconds per record, while a B-tree index needs 20 node reads at 5 ms each. Find the average time for each and the speed-up ratio. [4]

Section D Algorithms and Programming

Part D: 4 marks each, 16 marks in total.

13. Searching 1,000,000 sorted items, how many comparisons does linear search make on average, and how many at most for binary search? Find the ratio. [4]

14. Bubble sort on 12 items in the worst case (fully reversed) needs how many comparisons? If each comparison plus swap costs 1 microsecond, find the total time. [4]

15. For the naive recursive definition, how many calls does fib(10) make in total? Explain why memoisation reduces this greatly. [4]

16. Compare the number of operations for O(1), O(log n), O(n), O(n log n) and O(n^2) at n = 1024, and say which is least suitable for large inputs. [4]

Section E System Development and Testing

Part E: 4 marks each, 16 marks in total.

17. List the main stages of the system development life cycle (SDLC) and explain how weak requirements analysis raises later costs. [4]

18. A decision has 3 independent conditions. Under condition-combination coverage in white-box testing, what is the minimum number of test cases? Distinguish black-box from white-box testing. [4]

19. Compare the waterfall model with agile development, and explain why agile suits projects whose requirements change often. [4]

20. Explain the purpose and practice of user acceptance testing (UAT), and the role of version control such as Git in team development. [4]

Section F Ethics and Sustainable Computing

Part F: 5 marks each, 20 marks in total.

21. Compare free and open-source software (FOSS) with proprietary software in licensing, cost and risk, giving one suitable scenario for each. [5]

22. State four of the six data protection principles in the Personal Data (Privacy) Ordinance and explain how a school should handle student data. [5]

23. Explain where bias can enter decisions made with big data or machine learning, and give two measures to reduce the risk. [5]

24. A data centre draws 400 kW for IT equipment and 500 kW in total. Find its PUE, then the annual emissions in tonnes if it runs 8 760 hours a year at 0.6 kg CO2 per kWh. Suggest one way to lower the PUE. [5]
