# S5 ICT Practice Paper

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

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## Part A: Data Representation and Databases (17 marks)

**Answer all 4 questions. Show all working and units.**

**1. A digital photo is 12 MB and a 64 GB card has 90% free space. Find the maximum number of photos it can hold (1 GB = 10^9 bytes, 1 MB = 10^6 bytes).**

**2. Convert the binary number 10110110 to denary and hexadecimal, and explain why 8 bits can represent 256 different values.**

**3. A table has 12,000 rows and 8 columns averaging 20 bytes each. Find the data size in MB and state the role of the primary key.**

**4. A query without an index scans all 12,000 rows; with a B-tree index it needs 3 index reads plus 1 data read. Find the improvement factor and state one SQL measure that would speed up the query (hint: index the column used in WHERE).**

## Part B: Computer Networking and Subnetting (17 marks)

**Answer all 4 questions. Show the subnet mask and number of usable hosts.**

**5. A /24 network must be split into 4 subnets with at least 50 hosts each. Which prefix should be used? Give the subnet mask, addresses per subnet and usable hosts.**

**6. A 240 MB file is sent over a 100 Mbps link with 20 ms one-way latency. Find the transmission time and the total time until the last bit arrives.**

**7. A 1000 Mbps campus link carries an average of 620 Mbps at peak. Find the utilisation and state two consequences of sustained utilisation above 80%.**

**8. A 6,000,000 byte file is sent over a network with a 1500 byte MTU and a 20 byte IP header per packet. Find the number of packets, total header overhead and transmission efficiency (%).**

## Part C: Programming and Algorithm Analysis (17 marks)

**Answer all 4 questions. Show trace tables or calculation steps.**

**9. Trace the code: s = 0; for i in range(1, 5): s = s + i * i. Find the final value of s and state how the result changes if the range becomes range(1, 6).**

**10. Searching 1,000,000 sorted items takes 1,000,000 comparisons in the worst case for linear search and 20 for binary search. Find the improvement factor and state two conditions binary search requires.**

**11. Bubble sort on 40 items needs n(n-1)/2 comparisons in the worst case; insertion sort on already sorted data needs n-1. Find both counts and explain the difference.**

**12. Using the recursive definition fib(n) = fib(n-1) + fib(n-2) with fib(0) = 0, fib(1) = 1, compute fib(7). Give the value, the total number of recursive calls, and one benefit of an iterative version.**

## Part D: System Development and Project Management (17 marks)

**Answer all 4 questions. Costs are in dollars; show your working.**

**13. A project needs 12 analyst days at $2,400 per day, 20 programmer days at $1,800 and 8 tester days at $1,200. Find each role cost and the total development cost.**

**14. Three project paths need 19, 13 and 16 weeks. Find the shortest completion time and the critical path, and explain the effect of any delay on it.**

**15. Development costs $74,400 with a 12% contingency reserve. Find the reserve and the total budget, and explain why a reserve is held.**

**16. The same project uses agile delivery: 4 sprints of 3 weeks plus 2 weeks of system testing, 14 weeks in total. Against the 19 week traditional plan, find the weeks and percentage saved and state one agile risk.**

## Part E: Information Security and Risk Management (16 marks)

**Answer all 4 questions. State units for probability and risk values.**

**17. A password uses upper case, lower case and digits only (62 characters). Compare the number of 6-character and 8-character passwords and find how many times larger the 8-character space is.**

**18. If an attacker can test 1e+09 passwords per second, how many seconds and days are needed on average to exhaust an 8-character space? Suggest two defences.**

**19. Compare the key space of 128-bit AES with 56-bit DES and find the ratio; explain why modern systems use AES rather than DES.**

**20. Three assets are valued at $500,000 (p=0.2), $240,000 (p=0.35) and $60,000 (p=0.6) per year. Find the current total risk exposure and, if controls cut the probabilities to 40% of present values, the risk reduced and the percentage reduction.**

## Part F: Emerging Technology and Social Impact (16 marks)

**Answer all 4 questions. Amounts are in US dollars and energy in kWh.**

**21. Cloud storage is 1,200 GB at $0.023 per GB per month and egress is 300 GB at $0.09 per GB. Find the monthly and annual cost.**

**22. An image model needs 0.4 s of GPU time per image and handles 8,000 images a day. Find the GPU hours per day and explain why batch processing helps.**

**23. A district has 2,000 households and 620 have no fixed broadband. Find the percentage and suggest two ways to narrow the digital divide.**

**24. A data centre has an IT load of 400 kW and a PUE of 1.35. Find the total power, annual energy over 8,760 hours and annual electricity cost at $1.2 per kWh, and state one way to lower PUE.**

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