S5 Information and Communication Technology Practice Paper: Number Systems and Data Representation, Hardware and Storage Capacity, Data Communication, Network Security, Multimedia and Compression, Databases and Algorithms

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

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Part A: Number Systems and Data Representation (16 marks)

Show the conversion steps.

1. Convert the binary number 11011010 into a decimal number. [4]

Answer: Answer: 218 (128 + 64 + 16 + 8 + 2).

2. Convert the decimal number 203 into an 8-bit binary number. [4]

Answer: Answer: 11001011 (128 + 64 + 8 + 2 + 1).

3. Convert the hexadecimal number 3F into a decimal number. [4]

Answer: Answer: 63 (3 x 16 + 15).

4. A plain text file has 480 characters and each character is stored in 8-bit ASCII. Find the file size in KB. [4]

Answer: Answer: 0.469 KB (480 x 8 / 8 = 480 B, then divided by 1024).

Part B: Hardware and Storage Capacity (16 marks)

Use 1024 as the base for capacity conversion.

5. A 512 GB solid-state drive has 320 GB used. Find the free space in GB and the free percentage. [4]

Answer: Answer: 192 GB, 37.5 percent free (192 / 512 x 100).

6. A drive labelled 2 TB offers 1.8 TB of usable space. Find the usable percentage of the labelled capacity. [4]

Answer: Answer: 90 percent (1.8 / 2 x 100).

7. A processor runs at 3.2 GHz and executes one instruction per clock cycle. Find the number of instructions per second in millions. [4]

Answer: Answer: 3200 million instructions (3.2 x 1000).

8. A program needs 2.4 x 10^9 instructions and the processor handles 3.0 x 10^9 instructions per second. Find the run time in seconds. [4]

Answer: Answer: 0.8 s (2.4 / 3.0).

Part C: Data Communication and Network Transmission (16 marks)

1 byte = 8 bits and bandwidth uses decimal units.

9. A 750 MB file is sent over a 100 Mbps network. Find the time needed in seconds. [4]

Answer: Answer: 60 s (750 x 8 = 6000 Mb, then divided by 100).

10. A network link of 50 Mbps runs for 8 minutes. Find the amount of data transferred in MB. [4]

Answer: Answer: 3000 MB (50 x 480 = 24000 Mb, then divided by 8).

11. A host has the address 192.168.10.35 with subnet mask 255.255.255.0. State the network address and the number of usable hosts in the subnet. [4]

Answer: Answer: network address 192.168.10.0; 254 usable hosts (2 to the power 8 minus 2).

12. A backup of 24 GB is transferred at 16 MB/s. Find the time needed in minutes. [4]

Answer: Answer: 25.6 minutes (24 x 1024 = 24576 MB, divided by 16 gives 1536 s).

Part D: Network Security and Access Control (16 marks)

Show the working for each count.

13. A 128-bit symmetric key is attacked at 10^9 keys per second. Find the worst-case exhaustive search time in years, taking 3.15 x 10^7 s per year. [4]

Answer: Answer: about 1.08 x 10^22 years (2 to the power 128 / 10^9 / 3.15 x 10^7).

14. A 4-digit PIN allows repeated digits. Find the number of possible PINs; if digits cannot repeat, what is the number of PINs? [4]

Answer: Answer: 10000 with repetition; 5040 without repetition (10 x 9 x 8 x 7).

15. A password consists of 3 capital letters, which may repeat. Find the number of possible passwords. [4]

Answer: Answer: 17576 (26 to the power 3).

16. In a system 20 percent of users have 8-character passwords and the rest 6-character ones. If cracking takes 16 hours on average for 8 characters and 1 hour for 6, find the average cracking time per user in hours. [4]

Answer: Answer: 4 hours (0.2 x 16 + 0.8 x 1).

Part E: Multimedia Files and Compression (16 marks)

Colour depth is measured in bits per pixel.

17. An image is 1024 x 768 pixels at 24-bit colour. What is its uncompressed size in MB? [4]

Answer: Answer: 2.25 MB (1024 x 768 x 3 B, then divided by 1048576).

18. The image above is compressed to 384 KB. Find the compression ratio and the percentage of space saved. [4]

Answer: Answer: 6 to 1, saving 83.3 percent (2304 / 384 = 6).

19. A stereo recording is sampled at 44.1 kHz with 16 bits per sample for 30 seconds. Find the file size in MB. [4]

Answer: Answer: 5.05 MB (44100 x 16 x 2 x 30 / 8 / 1048576).

20. An uncompressed video has 25 frames per second at 1.2 MB per frame and lasts 4 minutes. Find the file size in GB. [4]

Answer: Answer: 7.03 GB (25 x 1.2 x 240 = 7200 MB, then divided by 1024).

Part F: Databases and Algorithms (20 marks)

Write down the formula used.

21. A table has 5 fields and 1200 records, averaging 200 B each. Find the table size in KB. [5]

Answer: Answer: 234.4 KB (1200 x 200 = 240000 B, then divided by 1024).

22. A sorted table holds 800 records and binary search is used. Find the number of comparisons in the worst case. [5]

Answer: Answer: 10 comparisons (2 to the power 9 is 512, which is too small; 2 to the power 10 is 1024).

23. A program adds the squares of the integers from 1 to 50. Find the final total and the number of loop iterations. [5]

Answer: Answer: 42925 with 50 iterations (50 x 51 x 101 / 6).

24. For sorting 1024 records, how many comparisons does bubble sort need in the worst case, and about how many does merge sort need? [5]

Answer: Answer: bubble sort 523776 comparisons (1024 x 1023 / 2); merge sort about 10240 (1024 x log2 1024).
