

THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION Certificate

TECHNOLOGY

16th October 2003, 2.30 p.m.-4.30 p.m.

Time: TWO hours

SECTION A

Answer TWO questions out of FOUR. All questions carry equal marks.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

1. A typical high-performance personal computer employs a wide variety of memory subsystems, many of which use a different storage technology (for example, semiconductor dynamic memory and optical storage).
 - a) Why don't computer manufacturers use one single memory technology? **(6 marks)**
 - b) Describe the characteristics (brief principle of operation, speed and capacity, cost) of the memory technologies found in a typical high-performance personal computer. **(18 marks)**
 - c) A hard disk has a rotational speed of 15,000 rpm. A track contains 128 sectors and each sector holds 1,024 bytes. Derive an algebraic expression for each of the following and calculate their values.
 - i) The rotational latency.
 - ii) The time taken to read a sector once it has been located.
 - iii) The rate at which data is read from a sector. **(6 marks)**
2. The Internet has created one of the most powerful tools imaginable for a wide range of people. Academics can use it to carry out research without having to go to a library. People can use it at home to keep in touch with friends round the world. Some can book flights and hotels on-line.
 - a) Unfortunately the Internet is vulnerable to a range of attacks or abuses from those who would commit mischief. Some threats are from malicious programs and some from those who would use the Internet to carry out fraudulent activities.

Describe the various types of malicious threats to the Internet. **(18 marks)**
 - b) What can be done to deal with such threats to the Internet? **(12 marks)**
3. Consider the calculation $S = \sum x_i \cdot y_i$.

This expression takes pairs of elements in two vectors, multiplies them together and adds them to a total. This expression is also called an *inner-product*.

With the aid of appropriate diagrams describe how such an expression is evaluated by a computer at the machine level. HINT: What addressing mode is made use of during the evaluation of this expression?
Your explanation should include a discussion of the von Neumann computer, its buses, register, functional units, machine-level instructions and addressing modes. **(30 marks)**

Turn over]

4. All computers provide input and output systems in order to communicate with devices ranging from the video display to the mouse, modem, and scanner.
- A common I/O mechanism is the so-called “interrupt”. Explain what an interrupt is and how it is used to implement an I/O mechanism. **(15 marks)**
 - A particular computer takes 5 μs to call an interrupt handler in response to a peripheral. It takes the peripheral 10 μs to set up a data transfer and then information can be transferred across a 16-bit parallel data bus at the rate of 2500 transfers in 10 ms. It takes the computer a further 15 μs to return from the interrupt.

If this computer does nothing other than respond to interrupts from the peripheral, what is the maximum sustained data rate that can be achieved? Carefully explain all your workings and assumptions. **(10 marks)**
 - Why has the USB interface proved to be so very successful? **(5 marks)**

SECTION B

Answer FIVE questions out of EIGHT. All questions carry equal marks.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

5. Give a brief description of each of the following, and state their functions in a computer system:
- cache memory
 - main memory
 - registers
 - virtual memory
- (4 x 3 marks)**
6. Perform the indicated operations.
- Convert the following numbers to twos complement and find their difference using twos complement arithmetic: 125, -34.
 - 010001 AND 101010
 - 100110 XOR 110011
 - Write the following hexadecimal number as a binary number: ABDE
- (4 x 3 marks)**
7. Write short notes on each of the following:
- Computer viruses
 - Search engines
 - Web browser
 - IP address
- (4 x 3 marks)**
8. Simplify the following function and draw a circuit for the reduced function.
- $$\overline{A} \overline{B} \overline{C} D + \overline{A} B \overline{C} D + A B \overline{C} D + A \overline{B} \overline{C} D + \overline{A} B C \overline{D} + A B C D$$
- (12 marks)**
9. Briefly explain the purpose of a personal computer's operating system and, in particular, its interaction with the hardware. **(12 marks)**

