

**THE BCS PROFESSIONAL EXAMINATION
Certificate**

April 2005

EXAMINERS' REPORT

Technology

General

Quite a few of the candidates did not indicate or indicated in various ways on the front sheet which questions they had answered. A small number of candidates did not attempt the requisite number of questions, and a smaller number attempted more questions than was required. In a few cases the answers were hardly legible and showed poor use of spelling and/or grammar.

It is also very unfortunate to note that many candidates and course providers did not analyse past trends for this paper. Some elements of the paper have been examined during previous sittings. If candidates had paid attention to this, they would have been better prepared, and accordingly written good answers.

Question One

1. a) The *stored program* von Neumann digital computer executes instructions in a *two-phase fetch/execute* mode.

Explain what we mean by the following terms used in the above statement:

- i) stored program
- ii) fetch/execute mode (also called fetch/execute cycle)

(6 marks)

- b) The processor (CPU) is constructed from *registers*, *buses* and *functional units* such as the ALU (arithmetic and logical unit).

Explain what we mean by '*registers*', '*buses*', and '*functional units*' and show how each of these contributes to the performance of a digital computer. Use diagrams to illustrate your answer where necessary. **(9 marks)**

- c) A computer's instruction (at the machine language level or the assembly language level) may have a one-address, two-address or three address instruction format. Explain what we mean by '*one-address*', '*two-address*' and '*three address*' instruction formats. Provide simple examples of these instructions. **(5 marks)**
- d) Each type of computer (e.g., Pentium, 68K, ARM, PowerPC) has a unique instruction set. Although there are considerable variations between computers, most computers have broadly similar instructions (in terms of the operations they carry out).

Describe the basic features and characteristics of a computer's instruction set (i.e., instruction types, register structure, addressing modes).

You may choose a real computer or you may use a hypothetical computer to illustrate your answer. The question is intended to test your knowledge of basic instruction types (i.e., classes) and addressing modes.

(10 marks)

Answer Pointers

- a i) The first part required students to explain that program and data is stored in the same memory whereas previously the two were stored separately.

- a ii) The second part required students to explain the phases involved in the fetch/execute cycle.

Fetch: An instruction is read from memory and decoded.

Execute: The instruction is executed or interpreted.

- b) Students were asked to show their understanding of the internal workings of the CPU by explaining its constituent parts namely registers, buses and functional units such as the ALU (arithmetic and logical unit). Students could use a diagram to guide them through the explanation.
 - c) One-address: only one operand specified eg ADD X (the contents of X are added to the accumulator)
Two-address: two operands specified eg ADD A, B (A is overwritten with the result of adding the two operands)
Three-address: three operands specified eg ADD A,B,C (A is empty, the result of adding B and C is put into A).
 - d) Instruction types: fall into different categories such as data movement, arithmetic, logical and program flow control. Students were expected to recognise these categories and give examples of each.
- Addressing modes:
- a. Direct/Absolute address: ADD 1234, D2 (add the contents of 1234 to D2)
 - b. Immediate Address: ADD 1234, D2 (add the value 1234 to D2)
 - c. Indirect address: ADD (A1), D2 (add the contents of memory location pointed at by register A1 to D2).
 - d. Indexed address: ADD (12,PC), D2 (12 is the offset, add the contents of the memory location 12 bytes from the current location to D2)

Examiner's Guidance Notes

This was a fairly popular question but quite a few students gave good answers for parts a & b but lost marks because they did not attempt sections c & d.

Only a few students answered part ai) fully, others just gave a partial answer or omitted it altogether. Most students answered part aii) correctly, some students lost marks if they did not include decoding of the instruction in their explanation.

In general part b) was answered quite well. Higher marks were awarded to students who gave a correct diagram and full descriptions of registers, buses and functional units. Marks were lost if students did not include a diagram or gave short answers. For example when describing the ALU, some students did not include examples of the logical operations such as AND, OR, NOT, consequently they did not get full marks. Generally students answered part c quite well. Some students did not include examples of each instruction format and consequently were not awarded full marks. A small minority of students confused these instruction formats with addressing modes. For part d) the performance on this was quite patchy. The students who understood addressing modes gave full and accurate descriptions. Quite a few students did not attempt this section.

Question Two

2. A major contribution to the success of the personal computer has been the use of the graphical operating system, of which Windows™, is an example.

- a) Explain the facilities provided by such an operating system to a typical modern PC. You should include facilities that are *visible* to the user and facilities that are *invisible* (i.e., *transparent*) to the user (e.g., memory management).

Your answer should include reference to the way in which operating systems have expanded to include functions that were once not associated with operating systems (e.g., facilities that cover communications and networking).

- b) What are the major limitations of current operating systems (i.e., what limitations or weaknesses do they have and how can they be improved)?

Your answer should conclude with a discussion of the way in which you expect operating systems for personal computers to develop over the next few years.

(30 marks)

Answer Pointers

This is a fairly open-ended question which more or less fell into two parts. The first part required students to describe the general functions of an operating system especially in terms of activities that are visible (eg user interface) & invisible (eg memory management)

The second part of the question required students to reflect on the limitations of operating systems and discuss future developments of operating systems. For example security is still a major limitation. Operating systems could be expanded in areas such as multimedia, improved security, accessibility issues (eg special interfaces for the blind/deaf) etc.

Examiner's Guidance Notes

This was a fairly popular question. Mostly because we are all familiar with operating systems and have experience of using them. So students were able to use their knowledge and experience in answering this question. Students tended to give full descriptions of the functions of an operating system. However quite a few did struggle to give good answers to the limitations and future developments.

Question Three

3. a) All computers have to provide input/output mechanisms to enable information from the external world to be read into the computer and information from the computer to be sent to the external world.

Describe the ways in which a computer may implement an I/O strategy for transferring information between itself and external peripherals. For the purpose of this question you may consider the disk drive and display system to be external peripherals.

(20 marks)

- b) A computer processes digital images. These images are 10 cm x 16 cm and are printed at a resolution of 30 pixels/cm. Each pixel consists of a dot in one of the three primary colors plus a 'grey' dot. Each of these four dots that make up a pixel has one of 256 levels of intensity.

An image is transmitted over a data link in the form of frames, where each frame consists of 256 bits of user (i.e., image data) and 64 bits of control and routing data. The data link transmits information at a rate of 64Kbits/s./

- i) How large is each image in bytes?
ii) How long does it take to transmit an image?

(10 marks)

Answer Pointers

- a) I/O strategies – programmed I/O involves polling, it is slow but simple.
Interrupt-driven I/O responds to peripherals in real time
Direct memory access is fast but complex.
- b) i) Resolution of a square is $30 * 30 = 900$
Area of the image is $10 * 16 = 160$
Number of pixels per image is $900 * 160 = 144,000$
Each pixel is 4 dots. Each dot is represented by 256 levels which is encoded as 8 bits.
Bits/pixel is $4 * 8 = 32$.
The total bits/image is $(144,000 * 32) = 4,608,000$
Size of an image is $4608000/8 = 576,000$ bytes.
- ii) Speed of transmission – $5760000/(64*1024) = 87.9s$

Examiner's Guidance Notes

This was the most poorly answered question in section A. Marks were gained mostly for part a), no-one got full marks for part b). Most students got the correct answer for area of the image but forgot to square the resolution value.

Question Four

4. The success of the personal computer revolution owes as much to the development of versatile, powerful, low-cost peripherals such as DVDs, USB and FireWire interfaces, BlueTooth and WiFi, and Flash memory as much as to developments in computer architecture and semiconductor technology.

Explain how the above features have contributed to the continuing success of the personal computer.

You should provide details of the characteristics of these new technologies and their applications and features, but you are not required to provide in-depth descriptions of their operating modes.

(30 marks)

Answer Pointers

This is an open-ended question which required students to show their understanding of how the development of versatile, powerful, low-cost peripherals have contributed to the success of the personal computer revolution. In order to be able to do this students must be aware of each of these peripherals and the benefits they provide. Also the multimedia capabilities have improved due to the development of these peripherals such as DVDs, USBs and FireWire. Mobile computing has taken off due to peripherals such as BlueTooth, Wifi and Flash memory.

Examiner's Guidance Notes

This was a popular question and students answered this well. Only a few students confused firewalls with firewire. Fuller answers gained higher marks.

Section B

Question 5

5. For each of the following pairs of terms, differentiate between:

a) a *local area network* and a *wide area network*

(6 marks)

b) a *router* and a *switch*

(6 marks)

Examiner's Guidance Notes

- a. This section of the question was well attempted. On average, candidates scored 4 marks. Suitable explanations were provided for local and wide area network.
- b. This section was either very badly attempted or completely ignored. Very few candidates were able to differentiate between a router and a switch. Most candidates mentioned that a router is an expensive device that is used in connecting large networks.

Question 6

6. Differentiate between *hypertext transfer protocol* and *hypertext markup language*. Explain how each of the techniques is used. (12 marks)

Examiner's Guidance Notes

Candidates provided general comments on http and html. Answers lacked preciseness and clarity on what can be done with http and html. Most candidates knew that html was a language used for website development. Good answers include the use of tags in html.

Question 7

7. The internet has made users vulnerable to various malicious threats.
- a) Describe the threats faced by internet users. (6 marks)
 - b) Suggest possible actions users should take to deal with such threats. (6 marks)

Examiner's Guidance Notes

This question was popular among candidates.

- a. Most candidates were able to identify common threats such as viruses and hackers. Answers lacked descriptions and depth. Other issues that could have been raised include spyware and spam.
- b. This section of the paper was well attempted. Answers included anti virus software and firewalls.

Question 8

8. Carry out the following operations
- a) Convert $2D6_{16}$ to binary (3 marks)
 - b) 11100111_2 OR 11111111_2 (3 marks)
 - c) $10011001_2 + 11110101_2$ (3 marks)
 - d) 10101011_2 AND 11111001_2 (3 marks)

Examiner's Guidance Notes

This was the easiest 'give away' question. Most candidates who attempted this question were able to score maximum marks. Weaker candidates confused binary addition with OR operation.

Question 9

9. As computers become more sophisticated, users find it more difficult to understand the meaning of some of the 'computer jargon' found in newspapers and journals.

Using non-technical terms, produce a simple description of a modern personal computer. Your answer should cover the computer's hardware, software and networking components. **(12 marks)**

Examiner's Guidance Notes

Few candidates managed to produce suitable answers to this question. Candidates were unclear on how to structure their answers. Good answers discussed hardware, software and networking components in non-technical terms. Some candidates ignored the non-technical requirement of this question and merely described various elements such as motherboard, memory and registers.

Question 10

10. Peripheral devices are very important to the CPU of a computer.

a) Explain the relevance of the above statement. **(6 marks)**

b) Describe the main characteristics of a DVD as a peripheral device. **(6 marks)**

Examiner's Guidance Notes

Most candidates who attempted this question agreed with the statement and produced reasonable answers. Candidates argued that without peripheral devices, the CPU will neither be able to receive data (input) nor produce information (output). At least one candidate totally disagreed with the statement and explained that peripheral devices were part of the CPU and there was no reason to make such a statement.

Section b) was poorly attempted. Very few candidates were able to provide a sensible answer in the context of a DVD as a peripheral device. Most candidates presented the DVD as a medium to store movies with various advanced options.

Question 11

11. The internet and electronic mail have become major aspects of our daily lives.

a) By means of examples describe and explain the function and importance of a web browser. **(4 marks)**

b) SPAM can seriously affect internet users. Explain what SPAM is. **(4 marks)**

c) Describe how users can protect themselves against SPAM. **(4 marks)**

Examiner's Guidance Notes

This was a popular and well attempted question.

- Good answers covered details of a web browser including an example such as Internet Explorer.
- Most candidates were aware of SPAM and its dangers. Answers focused on their personal experience of SPAM.
- Answers were reasonable and included spam filters and firewalls. Again, candidates drew on their personal experience to answer this question.

Question 12

12. a) Briefly, describe and explain the operation of a full adder. **(6 marks)**
- b) Using NAND gates only, show the construction of a half adder. **(6 marks)**

Examiner's Guidance Notes

This question was poorly attempted.

- a. Candidates failed to provide a description and operation of a full adder. Some candidates erred into Karnaugh Map which was not required.
- b. Candidates were unable to produce a relevant answer for this question.