

THE BCS PROFESSIONAL EXAMINATIONS
Certificate

October 2005

EXAMINERS' REPORT

Technology

Section A

General Comments

For some reason some students still had difficulty in indicating on the front sheet which questions they had answered. Perhaps student attention needs to be drawn to this and a sentence is required on the frontsheet which states 'Please circle the questions you have answered'. On the positive side, the number of students who have attempted fewer than the required number of questions or who have attempted more questions than was required has fallen. Students must take care on producing legible answers with correct spelling and/or grammar.

Question 1

1. A computer is able to execute the following code:

```
X = 12;  
Z = X + Y;  
IF Z > 4 THEN P = 2;
```

Note: This is *pseudocode* and does not represent any particular high-level language, although its meaning should be clear to the reader.

- a) Show how this high-level construct might be represented in the **assembly language** of a computer. (You may select a specific microprocessor or you may use a hypothetical 'teaching' computer). You must explain what each of the low-level (i.e., assembly language) instructions you have used does. **(10 marks)**
- b) With the aid of diagrams, explain how the low-level instructions you used in part a) are executed. Your explanation should describe the fetch/execute cycle and the way in which information flows in the processor as instructions are executed. You should use a diagram to describe the execution of one instruction (of your own choice) in your program in detail. **(20 marks)**

Answer Pointers

a) The students were required to show their knowledge of converting pseudocode to the equivalent form using any assembly language. They also had to demonstrate their understanding of the low level instructions by explaining the meaning of each of the instructions used.

The original pseudocode was:

```
X = 12  
Z = X + Y  
IF Z > 4 THEN P = 2
```

Answers similar to the following were required:

MOVE statements load the value of 12 into 1 register and the value of Y into another register. The ADD statement adds the value in each register and puts the result into

a register. Move the result from the register to memory location Z. The CMP statement can be used to compare Z with 4 and set the condition flags. Use a BLE statement to say that if $z \leq 4$ then exit otherwise move the value 2 to memory location P.

The actual instruction names will vary depending on which assembly language is used.

Part b) required students to use a diagram to show the steps involved in processing the low-level instructions and supplement this with a discussion. In doing this the students also had to include an explanation of the fetch/execute cycle.

Below is a full detailed CPU diagram.

Students need to explain the fetch cycle

FETCH: Program counter to MAR; increment PC ready for next instruction

Read current instruction from memory

Move instruction to Instruction register

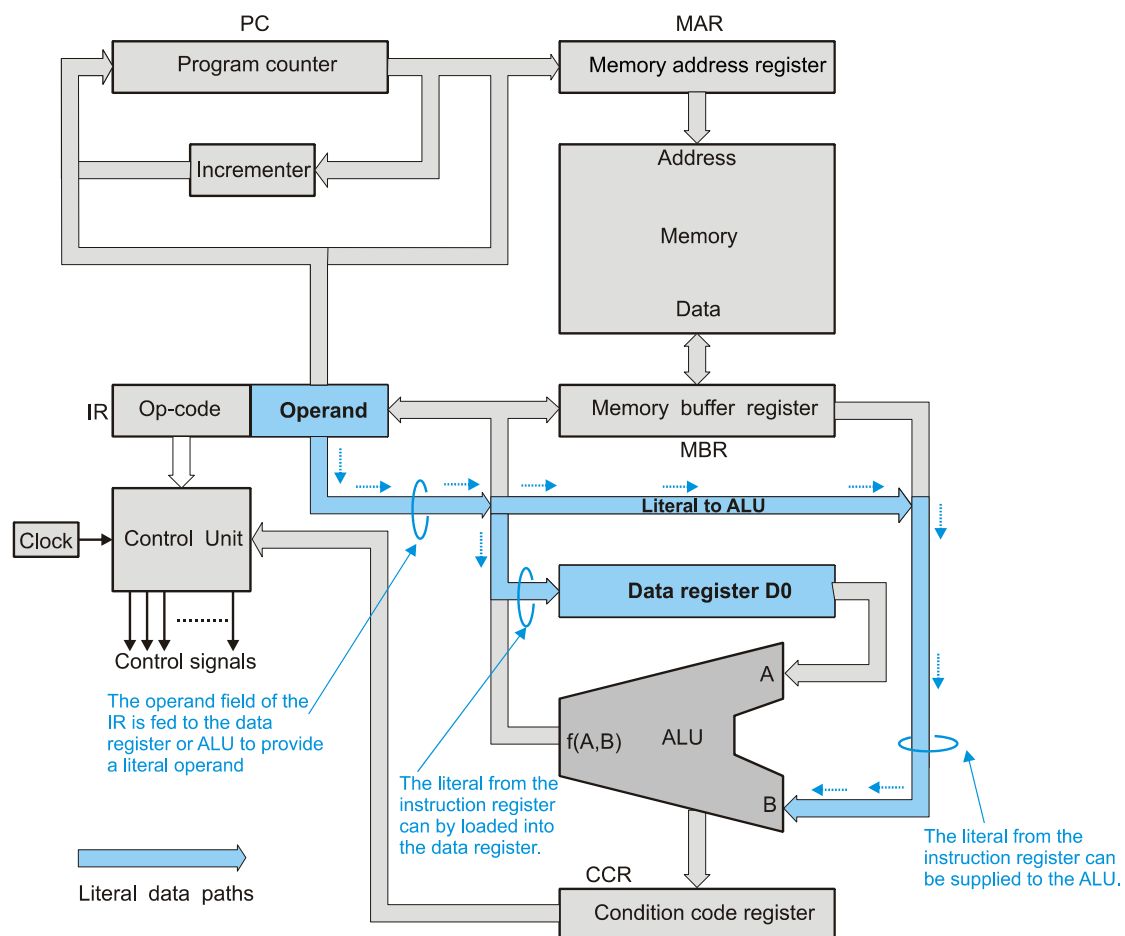
EXE: Typically a read and add (this instruction isn't in the program – it's illustrative)

Move address in IR to MAR

Read operand from memory and put in MBR

Move MBR and register to ALU, do addition

Store result in register



Examiner's Comments

This was the least popular question. Part a) was answered quite well although some students lost marks because they did not give explanations of the assembly language instructions. For part b) some students gave good explanations of the steps involved in processing the instructions but failed to produce a good diagram and consequently achieved lower marks.

Question 2

2. a) How is a personal computer connected to the internet?

Your answer should include a brief description of the various systems (or technologies) that can be used to connect a personal computer to the internet. Your answer should also include a brief description of the performance (speed) of these technologies.

(10 marks)

- b) The internet makes it very easy to communicate with other computer users and to access data stored on other systems. However, the same internet brings with it dangers due to malicious programs such as viruses.

Explain what the computer user can do in order to avoid the dangers of the internet. Your answer should discuss the range of problems that the internet presents and the type of solutions available to deal with each of these problems. You should state briefly what this software does (i.e., how it works).

(20 marks)

Answer Pointers

This question required students to show knowledge of historical development of the internet technologies such as standard modem, ADSL broadband, through to WiFi. As computer specialists it is important to be aware of the different options available in connecting to the internet and be fully versed with the differences in speed. For the second part of the question, students were required to show their understanding of the problems that the Internet presents such as different forms of viruses (worms, Trojan horses etc), hacking, data spoofing, spamming and so on. Students needed to include a discussion on the various types of software solutions (e.g. Virus Checkers, Spam Filters, Firewalls) and more importantly how they work.

Examiner's Comments

This was the most popular question. Mostly because we are all familiar with the internet and its pros/cons so students were able to use their knowledge and experience in answering this question. Students tended to give full descriptions of the technology behind connecting to the internet. Part b) also produced some good answers but unfortunately some marks were lost by students who did not explain how the different software solutions worked to prevent the threats.

Question 3

3. Those who buy computers (especially large organizations such as government departments) have to buy the best computer they can for the available money.
- a) What factors govern the performance of a computer? Your answer should include both hardware and software considerations and you should consider the entire computer system. You do not have to consider the performance of external peripherals such as printers. (12 marks)
 - b) Explain how the performance of two computers may be compared? (10 marks)
 - c) Why is it difficult to compare the performance of two computers accurately? (8 marks)

Answer Pointers

This question was generally answered quite well. Students were aware of the different factors that govern the performance of computer (e.g. bus width, clock speed, number of operations that can be carried out per instruction, cache memory, multitasking operating systems).

For part b) students had to explain how the performance of two computers could be compared. For example, the comparison should involve exactly same test conditions e.g. same tests, testing range of different tasks, using benchmarking and so on. The last part of the question required students to show awareness of the fact that comparing performance of two computers is not straightforward as it first seems. The intricate differences and complexities between two computers make an accurate direct comparison very difficult to do.

Examiner's Comments

Marks were gained mostly for part a), the performance for part b) was reasonable but answers given for part c) were generally poor or absent altogether.

Question 4

4. In recent years, the personal computer has become the centre of the multimedia revolution.
- a) In the context of home computing explain the meaning of the term *multimedia* and describe how it is affecting both domestic and small business computer users. (14 marks)
 - b) What developments in computer technology have led to an increase in multimedia applications? (10 marks)
 - b) What developments in multimedia technology are likely to appear over the next two years and how do you think they will affect the computer user? (6 marks)

Answer Pointers

This is an open-ended question whereby students had to recognise that multimedia is a combination of visual and aural technologies. The technology allows users to carry out flight simulations which normally wouldn't have been possible because of the high cost of proper flight simulators. The emphasis is on the use of advanced graphics to present a visual world which the user can interact with using a joystick and describe its effect on domestic and small business computer users. In the home computing environment, multimedia can be used to process music (using MP3 files), produce professional quality images (e.g. with PhotoShop) and edit video from camcorders. Web presentations can be brought to life using a combination of these technologies by including text, interactive diagrams and video.

Small businesses can use multimedia to create sophisticated professional quality web presences at a much lower cost than would normally have been possible. This has boosted electronic commerce sales. Wide range of answers are possible here which show that the opportunities brought by multimedia are endless.

The second part of the question required students to cover four main areas relevant to multimedia i.e. I/O, processing, display and storage. Students had to show their understanding of the technology behind multimedia applications such as ability to transfer large quantities of data into or out of a computer using USB2, FireWire and broadband; process data in real-time using special instruction sets (e.g. INTEL'S MMX); Use of LCD for high resolution displays; large storage capacity devices such as DVDs, flash cards and so on.

The final part of the question required students to explain the future development trends in multimedia technology. For example improvements in processing power due to enhanced on-chip caches and multiple processors on the same chip. Other developments could be larger memory; organic LEDs for larger, cheaper displays; better connectivity using wireless networks; increased use of personal video systems and integration of cell phone technology

Examiner's Comments

Although there is no precise definition of multimedia, most students were able to give a clear explanation of what was meant by the term multimedia. Students tended to make a comparison with the features provided by computers prior to multimedia and the enhanced features provided by computers using multimedia.

Students answered the second part of the question very well and showed awareness of the main technologies involved in multimedia. However, there was some confusion on the last part of the question. Most students misinterpreted it by explaining the developments in terms of multimedia applications rather than developments in the multimedia technology.

Section B

Candidates' performance in section B was reasonable for this sitting. The standard of the answers was fairly good across the centres. Candidates managed to score a pass mark in most of the questions. Some improvements have been noted in the way candidates have chosen questions. In particular, candidates who chose question 8 scored well due to the simple binary arithmetic involved.

The most popular question was question 7 and the least popular was question 6.

Some candidates did not follow instructions clearly given at the front of the answer book. At some centres, candidates failed to encircle the questions they attempted. Other candidates started more than one question on the same page. The level of English was bad in some centres, hence the inability for candidates to express themselves clearly.

Question 5

5. The OSI (Open Systems Interconnection) is a standard description or 'reference model' for how messages should be transmitted between any two points in a telecommunication network.

Using a diagram, briefly describe the seven layers of the OSI model.

(12 marks)

Answer Pointers/Examiner's Comments

Whilst most candidates who attempted this question managed to list down the seven layers of the OSI model, they did not provide accurate descriptions of how each layer contributes to the interconnection of devices. Candidates either ignored to describe each layer or provided confusing answers. In many cases, candidates suggested the wrong technologies. For instance at level 2, it is inappropriate to mention FTP and telnet (found at layer 7). Instead, MAC and LLC are available at layer 2. Candidates should have included a diagram showing two devices (e.g. computers) interconnected to each other. The seven layers of the model should have been clearly shown on each device. Following this, specific features of each layer should have been highlighted.

A more detailed answer could also include information on how it is possible to use the OSI model to enable the interconnection of a range of devices irrespective of technologies or manufacturers, hence emphasising on the 'open-ness' of computer systems.

Question 6

6. With the aid of diagrams, explain the operation of a hard disk drive.

(12 marks)

Answer Pointers/Examiner's Comments

To explain the operation of a hard disk drive including a diagram; the structure of the hard disk consisting of several layers; the hard disk drive unit including the operation of the arms; the writing and reading of data including the cylinder concept. Candidates should have clearly explained that the drive operates under the control of the CPU and the Operating System.

Most candidates provided a diagram, though in some cases 'sketchy'. Others made an attempt to describe the physical structure of the disk consisting of tracks and sectors.

Question 7

7. Using suitable examples, explain the following terms in the context of computer security:

- a) Firewall
- b) Anti virus software
- c) File backup

(4 marks)

(4 marks)

(4 marks)

Answer Pointers/Examiner's Comments

Answers to this question were mostly vague. Candidates in some cases were content to provide brief explanations without any examples of how the security measures are used. Candidates should note that these security measures are widely used both for business and home purposes. It is not acceptable to argue that file backups are done only by large organisations such as banks.

- a) Firewall – a system of hardware and software acting as a filter; blocking unauthorised access/use of computer resources including data and software;

preventing malware entering the computer system; operates using specific ports; illustrations of firewall through examples of its wide use both for home/personal use and for organisational computer security.

Answers showed different levels of understanding of firewall. Some candidates focused on firewall options available in Microsoft Windows XP. This showed that they have been exposed to the basic features of a firewall. Good answers covered a fair description of firewall and its operation on IP address. Some candidates however failed to give proper examples of the use of firewalls.

b) Anti virus software – software used to detect and remove viruses from a computer system. Once the software is installed on the computer, it monitors all traffic on the system, then alerting users on potential infection. Regular updates of the software are required to ensure that new viruses are detected.

c) Files backup is described as a security measure where a copy of files is made and kept in a different location. In case the original files get lost or damaged, then the backup copies are used to recover/restore computer operations. Mediums that can be used for backup includes tapes and disks, carefully explaining that these devices must be removable and not part of the actual system from which backup is being made.

Question 8

8. Carry out the following operations:

- | | |
|------------------------------------|-----------|
| a) Convert 10.101_{10} to binary | (3 marks) |
| b) Convert 10101011_2 to decimal | (3 marks) |
| c) $B2F_{16} + 4AC_{16}$ | (3 marks) |
| d) $10011001 \text{ OR } 11110101$ | (3 marks) |

Answer Pointers/Examiner's Comments

This was a straight-forward question which tested candidates' ability to manipulate binary numbers. Simple operations were set. Candidates who attempted this question scored well, with some achieving the maximum mark. Candidates were penalised for not showing how they achieved the results (workings).

- a) In this section, some candidates were able to convert 10 to binary and had difficulties with the rest of the conversion. To convert .101 to binary, the number has to be multiplied by 2, and the process repeated and stopped at a point when no more multiplications can be done.
- b) This section proved to be easy for most candidates. The process involved dividing repeatedly by 2 and noting down the remainder until a final answer is obtained.
- c) Some candidates attempted to add the two hexadecimal numbers without converting these in binary. The proper way to tackle this problem was to convert each hexadecimal number into binary first, carry the addition and then convert the sum back to hexadecimal.
- d) Candidates confused between OR operation and binary addition. Clearly, applying an OR operation to two binary numbers produces a different answer to addition. Some candidates did not indicate the OR operation at all, making it even harder to figure what they wanted to do.

Question 9

9. Briefly describe each of the following terms and state their roles in a computer system:

- a) Interrupts
- b) Virtual memory
- c) Registers

(3 x 4 marks)

Answer Pointers/Examiner's Comments

Answers to this question were reasonable in general. Candidates were asked to describe each of the terms and explain their roles in a computer system. The latter part of the question was often ignored hence not enabling candidates to score the maximum mark.

- a) Interrupts - a signal generated for example by an I/O device informing the CPU that it needs attention. Interrupts can cause the CPU to suspend its current operation and service the request. These are called hardware *interrupts*. Interrupt signals initiated by programs are called software *interrupts*. A software interrupt is also called a *trap* or an *exception*.
- b) Virtual memory – An 'imaginary memory' supported by Operating Systems. The purpose of virtual memory is to enlarge the address space, the set of addresses a program can utilise. For example, virtual memory might contain twice as many addresses as main memory. A program using all of virtual memory, therefore, would not be able to fit in main memory all at once. Nevertheless, the computer could execute such a program by copying into main memory those portions of the program needed at any given point during execution.
- c) Registers - special, high-speed storage area within the CPU. All data must be represented in a register before it can be processed. For example, if two numbers are to be multiplied, both numbers must be in registers, and the result is also placed in a register. The register contains the address of a memory location where data is stored rather than the actual data itself. Examples of registers include PC, MBR, MAR, etc.

Some candidates provided very lengthy and detailed answers without describing the essential meaning of the terms.

Question 10

10. Differentiate between the following hardware items:

- a) Laser printer and ink jet printer
- b) Hard disk and DVD
- c) Program Counter and Memory Buffer Register

(4 marks)

(4 marks)

(4 marks)

Answer Pointers/Examiner's Comments

While answering this question, most candidates explained the technical aspects of each of the hardware items. For four marks, this was not the right thing to do. A suitable way to differentiate between each of the hardware items was to use specific features.

- a) In differentiating between laser and ink jet printers, features such as output quality, speed of printing, cost of operation and maintenance could be used. Many candidates explained the operation of each printers; some candidates mentioned that 'paper get burnt' in laser printers.
- b) The main difference between a hard disk and a DVD is that one uses magnetic medium whilst the other one optical medium. Storage capacity and speed of accessing data is higher for the hard disk.
- c) Both registers store memory addresses. The Program Counter holds the address in memory where the next instruction is to be found. The Memory Buffer Register holds the data that is to be transferred to and from the main memory.

Question 11

11. Since the introduction of the Personal Computer, there have been a lot of developments in operating systems.

Using examples, describe and explain the changes that have been made to operating systems.

(12 marks)

Answer Pointers/Examiner's Comments

This question was poorly attempted by candidates. This was an open ended question which required candidates trace the development of Operating Systems to date. A coverage of Operating System since it was used for the PC e.g. MSDOS to the recent Microsoft Windows was required although not in details. Development of Operating Systems can be highlighted through features such :

- Graphical User Interface compared to Command Line Interface
- User friendliness available through the Windows desktop
- Plug and Play facility
- Multitasking and Multi user environment

A brief description of open source environment available today through Linux could have also been included.

Some candidates described the functions of memory such as memory management, Job scheduling, etc. This type of answer was unsuitable for this question.

Question 12

12. Cache Memory can significantly increase the processing capacity of a computer.

- a) What is cache memory?

(6 marks)

- b) Explain how cache memory improves the performance of a computer.

(6 marks)

Answer Pointers/Examiner's Comments

Candidates who attempted this question did not manage to explain cache memory properly. Most candidates combined parts a) and b). One way to do this could be as follows:

Cache memory is a special high-speed storage mechanism. A memory, sometimes called a *cache store* or RAM cache, is a portion of memory made of high-speed static RAM (SRAM) instead of the slower and cheaper dynamic RAM (DRAM) used for main memory. Memory caching is effective because most programs access the same data or instructions over and over. By keeping as much of this information as possible in SRAM, the computer avoids accessing the slower DRAM. Disk caching works under the same principle as memory caching, but instead of using high-speed SRAM, a disk cache uses conventional main memory. The most recently accessed data from the disk is stored in a memory buffer. When a program needs to access data from the disk, it first checks the disk cache to see if the data is there. Disk caching can dramatically improve the performance of applications, because accessing a byte of data in RAM can be thousands of times faster than accessing a byte on a hard disk.