

# THE BCS PROFESSIONAL EXAMINATIONS Certificate

April 2006

## Examiners' Report

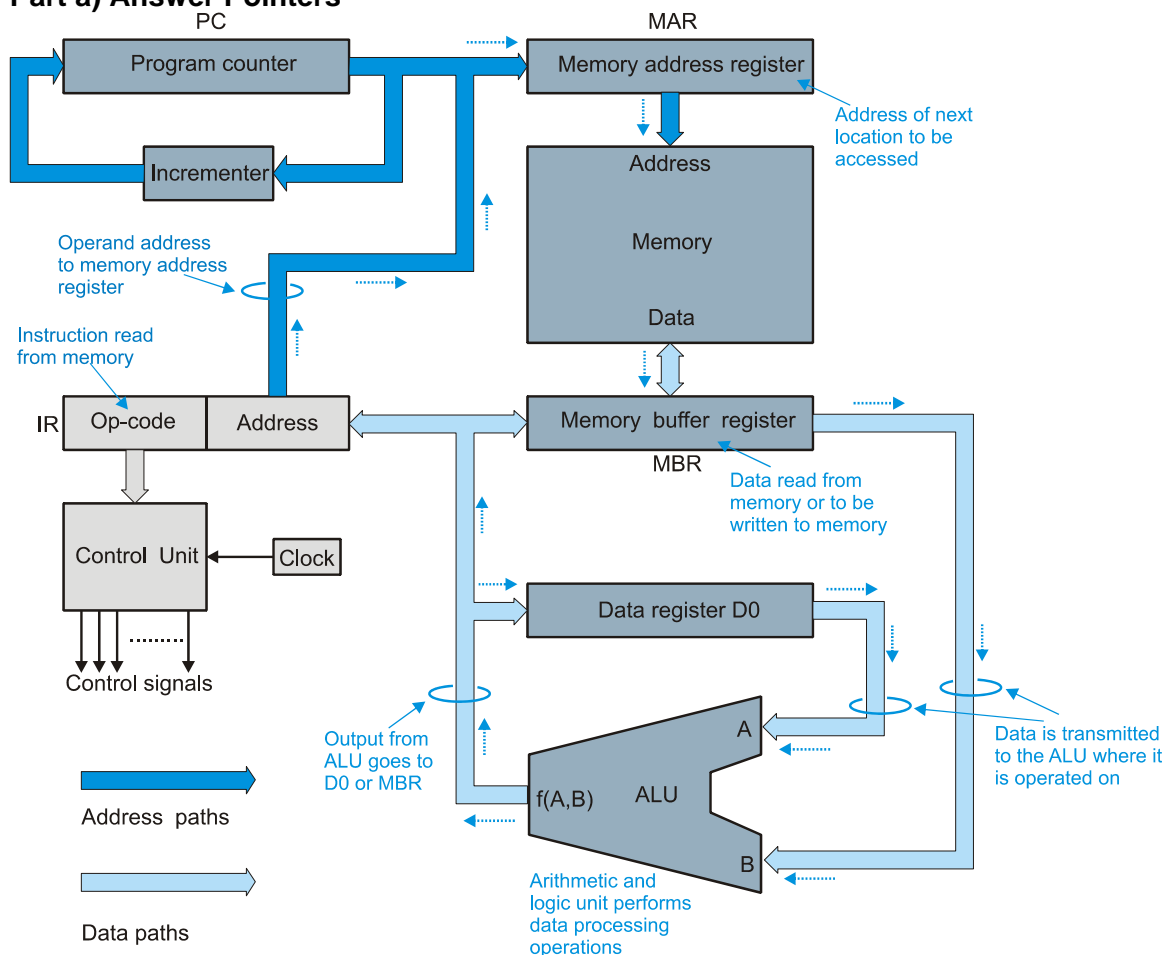
### Technology

#### Question 1

1. A microprocessor consists of functional units such as an ALU, registers, and buses.

- Describe the structure of a typical (but simplified CPU) that is able to read instructions from memory and execute them. **(10 marks)**
- By means of diagrams show how an instruction is fetched from memory and executed. Explain the role of all registers, functional units, and buses taking part in this activity. Comment briefly on the reason that this activity is called a 'fetch-execute' cycle'. **(20 marks)**

#### Part a) Answer Pointers



The diagram describes the structure of a CPU. Different candidates will describe the processor in different ways. However, the key features are the program counter that contains the address of the next instruction to be executed. The program counter is connected to the program and data memory. The processor reads the current instruction and transfers it (via the memory buffer register) to the instruction register.

A CPU has at least one data register and buses between the data register and memory buffer register to the ALU where operations are carried out. The output of the ALU is connected to both the data register (accumulator) and the memory buffer register (in order to write results into memory).

### **Part b Answer Pointers**

Using the diagram above.

1. The contents of the program counter (i.e., the pointer to the next instruction in memory) are copied to the memory address register. That is (in RTL)  $[MAR] \leftarrow [PC]$
2. The contents of the program counter are also sent to the incrementer in order to point to the next instruction in sequence, and the incremented value loaded in the PC. That is,  $[PC] \leftarrow [PC] + 1$  NOTE – in reality the increment is 2 to 10 (or more) because instructions can take a variable number of bytes in computers like the Pentium or 68K
3. The memory address register, MAR, currently contains the address of the next instruction to be executed. The memory uses this address and looks up that actual instruction op-code which is deposited in the memory buffer register, MBR. The MBR is sometimes called the memory data register. The read operation can be described as,  $[MBR] \leftarrow [[MAR]]$
4. The instruction copied into the MBR is transferred to the instruction register, IR. The instruction register holds instructions while they are being executed.  $[IRC] \leftarrow [MBR]$
5. The processor's control unit takes the instruction op-code bits and uses them to generate the signals (clock pulses, bus control, ALU and memory control).
6. Typically, an instruction might be, say, ADD P,D1 where P is a memory location and D1 a register. The computer now routes the address field of the IR to the memory address register and then performs a second read – this time to get the operand P. The computer then copies both P and the value of D0 to the ALU where P and D0 are address.
7. Finally, the output of the ALU transferred to the data register. However, if the instruction is ADD D1,P, the result would be sent to the MBR and a third memory access take place.

Candidates should be able to give a coherent description of the sequence of actions that take place in a computer as an instruction is fetched from memory and executed,

## Question 2

2. Email has been one of the greatest successes of the Internet. Email allows you to communicate with people or even large groups of people almost anywhere in the world nearly instantaneously.

Unfortunately, a considerable burden has been placed on the Email system by the large numbers of unwanted Emails, collectively called SPAM.

- a) Discuss why SPAM is such a problem today and describe its effects on the Email system. **(10 marks)**
- b) Discuss some of the ways in which SPAM may be defeated (including both technological and social or legal mechanisms). **(15 marks)**
- c) Describe some of the legal and ethical problems that arise when people attempt to deal with the threat posed by SPAM. **(5 marks)**

### Part a, Answer Pointers

SPAM is a form of email that is sent out in bulk (i.e., multiple copies) to many recipients. By definition, SPAM is email that the recipients did not request and, usually, do not want.

SPAM has many uses (i.e., it is sent for many reasons). However, the principal use of SPAM today is in advertising. An organization harvests internet addresses (either by using search engines or by obtaining the mailing lists of legitimate organizations). If an organization sends out, say, 100,000 SPAM emails and only 0.01% are successful (i.e., only 1 in 1,000 recipients buys the product) the operation may be economically successful.

SPAM causes several problems. First it consumes the Internet's bandwidth. It is reported that a considerable fraction of all emails are SPAM. These SPAM messages clog the system and delay legitimate mail and other Internet services.

SPAM requires recipients to filter email. This can be very time consuming if you receive tens or hundreds of SPAM messages a day. The problem is particularly bad if you are travelling and have to pay an ISP your connection time while in a hotel.

It is possible to create SPAM filters. However, these are not perfect and some SPAM gets through. More importantly, some legitimate emails are blocked as SPAM. This means that the need to block SPAM results in the loss of important messages.

Other problems of SPAM come from the effects of reading the SPAM by the recipient. For example, if the SPAM is fraudulent (typically, a message saying that someone will transfer \$10,000,000 to your account and let you keep 10% of the money if you help them – of course no one gives you \$100,000 for nothing - those who respond to this SPAM lose large sums of money).

### Part b, Answer Pointers

It is very difficult to defeat SPAM and there appears to be no single solution. Candidates should be given credit for any plausible suggestions that have.

There have been many suggestions about attacking SPAM. Some simply rely on legislation making it illegal to send SPAM. This has not proved particularly effective as it is difficult to successfully prosecute offenders. Moreover, SPAMers can move off-shore and send SPAM from countries with poorly developed telecommunications legislation.

It has been suggested that a cost be associated with messages. This may be a financial cost, say a few cents per message. It may be a computational overhead (a few seconds delay per message). Both techniques make it difficult to send large volumes of SPAM. However, many SPAMers do not send the SPAM themselves, they use viruses and Trojan horses to infect other computers and turn them into 'SPAMing Zombies'.

Other ways of dealing with SPAM is to set up lists of trusted users (possibly via a registration process) to ensure that bulk mail may come only from trusted sources.

### **Part c, Answer Pointers**

Those who send SPAM are exploiting the freedom people have in many societies to communicate with anyone you wish. Preventing SPAM means curtailing an important freedom. For example, in a society that does not have freedom of the press, an organization may send emails to people to let them know what is happening. Many would regard this as an essential freedom. However, such mail falls within the definition of SPAM.

Similarly, there are people who want to receive information about products and services. For example, you may wish to be informed of the latest movies or DVDs.

On the other hand, those who send SPAM believe that they are engaging in commerce – advertising and direct mail has been used for a long time. Such people believe that preventing SPAM interferes with legitimate trade.

Clearly, society has to decide where the balance between restricting email and allowing Internet uses to do as they wish.

However, if society does not find a solution to the SPAM problem, there is a possibility that the Internet and email system will collapse, leaving groups to create their own private subscriber-only email systems.

### **Question 3**

3. In the 1980s the microcomputer was expensive and its performance, peripherals and storage capacity were very poor compared with today's high-performance personal computers.

Today's very high-performance personal computer with its wide range of advanced peripherals (e.g., printers, scanners, wireless networks) enables people to perform sophisticated computer-based activities anywhere in the world.

- a) Explain how and why a modern computer allows you to 'perform sophisticated computer-based activities anywhere in the world'. **(10 marks)**
- b) Describe any THREE modern computer peripherals (excluding very simple peripherals such as the keyboard and mouse) and explain how their characteristics have improved over the years. You must briefly explain the improvement in operating principles of the peripherals you choose to describe. You should also give the approximate characteristics (i.e. operating parameters) of the peripherals you describe. **(20 marks)**

### **Part a, Answer Pointers**

A modern computer provides the facilities to automate the office. Documents can be scanned, images accepted from a wide range of sources from digital cameras to the Internet. Printers provide quality and speed at a reasonable cost. A modern inkjet printer can provide output as good as traditional photographic processes. Colour laser printers are available for the cost of monochrome laser printers a decade ago,

Wireless networks allow multiple computers to be interconnected in a single building (e.g., the home) and cable services permit a high-speed connection to the Internet. Unlike with conventional telecommunications, the Internet is 'free' and it costs little to transmit information across the world.

### Part b, Answer Pointers

This is entirely open ended. The marks were divided approximately equally between the three peripherals. Candidates should be able to describe a peripheral (its applications and principles of operation) and give its basic characteristics.

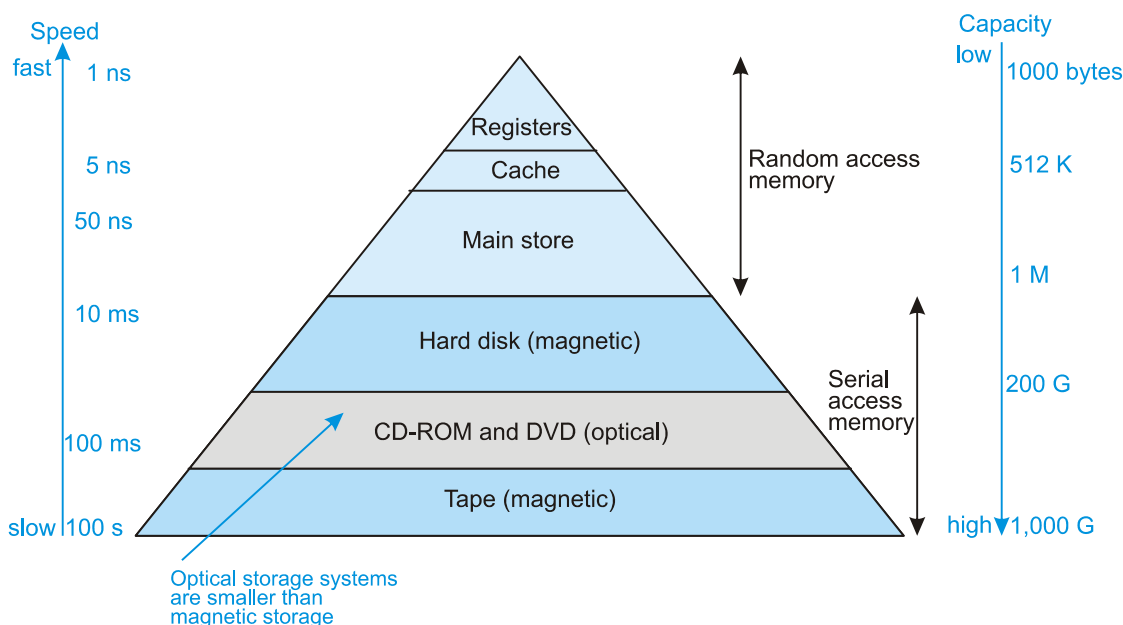
### Question 4

4. A high-performance computer employs several different memory subsystems, each of which uses a different storage technology (e.g., DRAM, flash memory, magnetic memory and optical storage).
- a) Explain why computer manufacturers do not use one single memory technology. (7 marks)
  - b) Describe the characteristics (brief principles of operation, speed and capacity, cost) of a hard disk. (18 marks)
  - c) What are the principal differences between the hard disk drive and a recordable DVD drive *from the user's point of view*? (5 marks)

### Part a, Answer Pointers

A memory hierarchy is required because no single technology provides all the necessary requirements of ideal memory; that is, low-cost, fast access time, non-volatile. By combining various memory technologies, it is possible to create a system with a memory system that has, collectively, the required requirements.

The diagram illustrates the nature of a memory hierarchy.



### Part b, Answer Pointers

Candidates were expected to describe the (multiple) rotating platters and the way in which a head (one per disk surface) records data along a concentric track. The track is divided into basic units called sectors (a sector is the smallest unit of data that can be read from or written to a disk).

Some candidates may describe the principle of magnetic recording (the read write head and the way in which data is recorded including the encoding process).

The read write head hovers above the surface (but not touching it) at a tiny fraction of an inch (the head to surface distance is the order of a wavelength of light).

The performance of disks has increased dramatically with 500 Gbytes now available. However, data access times have improved little. Disk typically rotate at 7,200 rpm and the fastest disks rotate at 15,000 rpm.

### Part c, Answer Pointers

The capacity of hard drives has increased more rapidly than that of optical storage. The standard DVD has a capacity of 4.7 Gbytes which is 1% of that of a large hard drive. However, the DVD provides very low cost removable storage and can be used for backup and archival purposes.

The access time of DVDs is not lower than that of the hard disk because the DVD rotates more slowly (it is not in a sealed enclosure). Moreover, the DVD's track is not concentric and is a spiral. Locating a specific point on a DVD is therefore slower than locating a sector on a disk. The head assembly in a DVD is far heavier than that in a hard disk and that means that the head cannot step rapidly from track to track. This reduces the access time of the DVD.

## SECTION B

### General Comments – Section B

Candidates' performance in section B was average for this sitting. The standard of the answers was fairly good across centres. Candidates managed to score a pass mark in most of the questions.

The most popular question was question 5 and the least popular was question 12.

As in previous sittings, most candidates did not encircle the questions' number in the front of their scripts. Candidates failed to write the question number at the top of every page of the scripts. Centres and course providers must be made aware of this so that they can impress the rule on their candidates. The level of English was bad in some centres, hence the inability for candidates to express themselves clearly.

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 5

5. Carry out the following operations showing all workings:

- a) Convert  $9D6_{16}$  to binary and octal (3 marks)
- b)  $11100111_2$  XOR  $01111111_2$  (3 marks)
- c)  $BC_{16} + AB_{16}$  (3 marks)
- d)  $10101011_2$  AND  $11111001_2$  (3 marks)

### Answer Pointers

All workings must be shown for this question, failure to do so will result into marks being deducted.

a) Convert  $9D6_{16}$  to binary and octal

$9D6_{16}$  converted to binary gives 1001 1101 0110<sub>2</sub>

To obtain the octal equivalent, the binary digits are grouped into 3's starting from the right hand side. So  $9D6_{16}$  gives 4556<sub>8</sub>

b)  $11100111_2$  XOR  $01111111_2$

Remember when XOR is applied to two binary strings, the output for each set of binary digits is 1 when either one of the input is 1, excluding when both inputs are 1.

So  $11100111_2$  XOR  $01111111_2$  gives  $10011000_2$

c)  $BC_{16} + AB_{16}$

Step 1 : Convert each hexadecimal number into binary first

$BC_{16}$  gives  $1011\ 1100_2$  and  $AB$  gives  $1010\ 1011_2$

Step 2 ; Add the 2 binary strings, so  $1011\ 1100_2 + 1010\ 1011_2$  gives  $1\ 0110\ 0111_2$

Step 3 : Convert the answer into hexadecimal,  $1\ 0110\ 0111_2$  gives  $167_{16}$

d)  $10101011_2$  AND  $11111001_2$

Remember when the AND operation is applied to two binary strings, the output for each set of binary digits is 1 when one input AND the other is 1.

So  $10101011_2$  AND  $11111001_2$  gives  $10101001_2$ .

### Examiner's Comments

This question was attempted reasonably well by candidates. The purpose of the question was to test candidates' ability to carry out binary, octal and hexadecimal operations. Overall, candidates were able to score a pass mark for the question. Marks were deducted for not showing workings. For part c, the correct procedure was to convert each hexadecimal number to binary first, add the two binary numbers and finally convert the binary sum to hexadecimal. Some candidates tried a different approach which did not result in the correct answer.

### Question 6

6. Briefly describe the difference between hypertext transfer protocol and hypertext mark-up language. Explain how each of the techniques is used. (12 marks)

### Answer Pointers

Hypertext transfer protocol (Http), the underlying protocol used by the World Wide Web. Http defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands. For example, when you enter a URL in your browser, this actually sends an Http command to the Web server directing it to fetch and transmit the requested Web page.

Hypertext Markup Language, the authoring language used to create documents on the World Wide Web. HTML defines the structure and layout of a Web document by using a variety of tags and attributes. The correct structure for a HTML document starts with `<HTML><HEAD>` (enter here what document is about) `<BODY>` and ends with `</BODY></HTML>`. All the information you'd like to include in your Web page fits in between the `<BODY>` and `</BODY>` tags.

### Examiner's Comments

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 included the use of tags in html. It should be noted that this question had been set previously.

### Question 7

7. In the context of networking, differentiate between the following pairs of terms:

a) router and switch.

(6 marks)

b) DTE and DCE

(6 marks)

### Answer Pointers

a) A router is a device that forwards data packets along networks. A router is connected to at least two networks, commonly two LANs or WANs or a LAN and its ISP's network. Routers are located at gateways, the places where two or more networks connect.

A switch is a device that filters and forwards packets between LANs segments. Switches operate at the data link layer (layer 2) and sometimes the network layer (layer 3) of the OSI Reference Model and therefore support any packet protocol. LANs that use switches to join segments are called *switched LANs*.

b) DTE short for Data Terminal Equipment, a device that controls data flowing to or from a computer. The term is most often used in reference to serial communications defined by the RS232 standard. This standard defines the two ends of the communications channel as being a DTE .

DCE short for Data Communications Equipment is used to refer to the connection of a device to the computer. A DCE is usually a modem.

### Examiner's Comments

This was a new question to this paper. Candidates were required to show their knowledge on popular networking devices. Such devices are widely used today. Candidates were unclear on the difference between router and switch. Few candidates were able to explain that a switch can be used in a typical LAN setup. A switch is a device that filters and forwards packets between LANs segments.

Routers on the other hand are more 'intelligent' devices which carry a range of functions within networks. A router is a device that forwards data packets along networks. A router is connected to at least two networks.

In part b, candidates were required to differentiate between DTE and DCE. Candidates were unable to describe these terms. DTE short for Data Terminal Equipment, a device that controls data flowing to or from a computer. The term is most often used in reference to serial communications defined by the RS232 standard. This standard defines the two ends of the communications channel as being a DTE.

DCE short for Data Communications Equipment is used to refer to the connection of a device to the computer. A DCE is usually a modem.



### Question 8

8. TCP/IP is a suite of *communication protocols* for connecting *hosts* on the Internet. In this context, describe the following terms:

- a) communication protocols and hosts
- b) IP address

(6 marks)

(6 marks)

### Answer Pointers

a) Communications protocols and hosts

All communications between devices require that the devices agree on the format of the data. The set of rules defining a format is called a protocol. At the very least, a communications protocol must define the following:

- rate of transmission (in baud or bps).
- whether transmission is to be synchronous or asynchronous.
- whether data is to be transmitted in half-duplex or full-duplex mode.

In addition, protocols can include sophisticated techniques for detecting and recovering from transmission errors and for encoding and decoding data.

### Hosts

A computer system that is accessed by a user working at a remote location. Typically, the term is used when there are two computer systems connected by modems and telephone lines. The system that contains the data is called the host, while the computer at which the user sits is called the remote terminal.

b) IP address

An identifier of a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination. The format of an IP address is a 32-bit numeric address written as four numbers separated by periods. Each number can be zero to 255. For example, 1.160.10.240 could be an IP address. Within an isolated network, you can assign IP addresses at random as long as each one is unique. However, connecting a private network to the Internet requires using registered IP addresses (called Internet addresses) to avoid duplicates.

### Examiner's Comments

Candidates briefly mentioned what communication protocols are. The explanations lacked accuracy. Although candidates were prompted to refer to TCP/IP, answers lacked preciseness. Candidates should have explained that all communications between devices require that the devices agree on the format of the data. The set of rules defining a format is called a protocol. At the very least, a communication protocol must define the following:

- rate of transmission (in baud or bps).
- whether transmission is to be synchronous or asynchronous.
- whether data is to be transmitted in half-duplex or full-duplex mode.

In addition, protocols can include sophisticated techniques for detecting and recovering from transmission errors and for encoding and decoding data.

Candidates' answers to hosts were one sentence explanation. Candidates should have explained that a host is a computer system that is accessed by a user working at a remote location. Typically, the term is used when there are two computer systems connected by modems and telephone lines. The system that contains the data is called the host, while the computer at which the user sits is called the remote terminal.

### Question 9

9. Electronic Commerce (E-Commerce) has become very popular in the last few years. Describe and explain how the internet has impacted on the development of E-Commerce. (12 marks)

#### Answer Pointers

A brief definition of E-Commerce, as buying and selling of goods and services. E-Commerce has been made possible through the internet. The main features include:

- Advertising and marketing
- On Line buying and selling
- On Line payment

Answers must also include the associated advantages of E-Commerce such as:

- No need to visit a shop
- Convenience, 24/7 shopping
- Browsing before buying

The problems with internet for E-Commerce include:

- Unwillingness of users to buy on-line because of security issues
- Internet fraud
- SPAM – unsolicited on line advertising emails.

#### Examiner's Comments

This question was attempted well. Candidates were able to raise a range of issues around E-commerce. Answers included explanations of e-commerce and how internet has made e-commerce a reality. Candidates mentioned facilities such as buying and selling, advertising and on line payment.

### Question 10

10. a) What is a Universal Serial Bus (USB)? (6 marks)  
b) Explain the importance of the USB in the modern Personal Computer. (6 marks)

#### Answer Pointers

a) A USB is an external bus standard that supports data transfer rates of 12MBps. A single USB port can be used to connect up to 127 peripheral devices, such as mice, modems, and keyboards.

b) One of the most important features of the USB is that it enables a computer system to automatically configure expansion boards and other devices. You should be able to plug in a device and play with it, without worrying about setting DIP switches, jumpers, and other configuration.

It is expected that USB will replace all serial and parallel ports.

#### Examiner's Comments

Candidates were able to explain what a USB is. Some candidates confused USB to a pen drive/flash memory. The question did not require candidates to give a detailed account of such devices. Instead, candidates were expected to describe that the USB can connect many external devices to the CPU of the computer.

In part b, candidates could have explained that one of the most important features of the USB is that it enables a computer system to automatically configure expansion boards and other devices. Due to its plug and play nature, today many devices can be connected to a computer through a USB with great ease.

### Question 11

11. With reference to wireless computing, explain each of the terms below:

- a) Wi-Fi
- b) Bluetooth technology
- c) PDA

(3 x 4 marks)

### Answer Pointers

Wireless computing is being used extensively today. Business and home users alike have access to a range of products which have been built to comply with a series of wireless technologies.

a) Wi-Fi short for Wireless Fidelity is meant to refer to wireless technology as used in the 802.11 network. Any products using such technology (tested and regulated by the Wi-Fi Alliance) must be interoperable with each other, even whether they are from different manufacturers. A user with a Wi-Fi product e.g. a laptop computer can use a brand access point with any other brand of client hardware.

b) Bluetooth technology refers to a short-range radio technology aimed at simplifying communications among internet devices and between devices and the internet. It also aims to simplify data synchronization between Internet devices and other computers.

Products with Bluetooth must be qualified and pass interoperability testing by the Bluetooth Special Interest Group prior to release. Bluetooth's founding members include Ericsson, IBM, Intel, Nokia and Toshiba.

c) PDA is short for Personal Digital Assistant, a handheld device that combines computing, telephone/fax, internet and networking features. A typical PDA can function as a cellular phone, fax sender, web browser and personal organizer. Unlike portable computers, most PDAs began as pen-based, using a stylus rather than a keyboard for input. This means that they also incorporated handwriting recognition features. Some PDAs can also react to voice input by using voice recognition technologies. PDAs are used by various groups of people for business and personal reasons.

### Examiner's Comments

This was a new question. Wireless computing is increasing in popularity. Candidates will be expected in future to be fully aware of the techniques used in transmitting data through wireless medium.

In part a, most candidates were able to explain that Wi-Fi short for Wireless Fidelity is meant to refer to wireless technology, but few went on and mentioned the 802.11 network. Candidates were also expected to be aware of the Wi-Fi Alliance. Good answers should have described that products conform to such standards must be interoperable with each other, even whether they are from different manufacturers. A user with a Wi-Fi product e.g. a laptop computer can use a brand access point with any other brand of client.

In part b, candidates were required to describe Bluetooth technology, but unfortunately repeated the answer they gave for Wi-Fi. A reasonable answer could have included issues around short-range radio technology aimed at simplifying communications among internet devices and between devices and the internet. Candidates could have also explained that it aims to simplify data synchronisation between Internet devices and other computers.

PDA is a popular device used for different reasons. Candidates should have explained that a PDA is a handheld device that combines computing, telephone/fax, internet and networking features. A typical PDA can function as a cellular phone, fax sender, web browser and personal organizer.

### Question 12

12. Describe and explain each of the concepts:

- a) system registry (as available in Microsoft Windows™, for example)
- b) multitasking, multithreading and multiprocessing.

(6 marks)

(6 marks)

### Answer Pointers

a) The system registry is one of the most important parts of a Windows-based computer system. Not to be tampered with lightly, the registry is a system-defined database used by the Windows operating system to store configuration information. Most Windows applications write data to the registry during installation and system components store and retrieve configuration data through the registry. The data stored in the registry varies according to the version of Microsoft Windows.

b) Typical features of Operating Systems:

Multiprocessing: Support running a program on more than one CPU.

Multitasking: Allows more than one program to run concurrently.

Multithreading: Allows different parts of a single program to run concurrently.

### Examiner's Comments

This question was badly attempted. Few candidates were aware of a system registry within Microsoft Windows™. Candidates should have explained that the registry is a system-defined database used by the Windows operating system to store configuration information. This is a very important component of the operating system and must not be tampered with.

In part b, candidates were required to explain straight forward terms. Most candidates confused one term with the other. Some candidates wrote a few words for each. Candidates must ensure that they are up to date with all Operating Systems functions available on computers.