THE BCS PROFESSIONAL EXAMINATIONS
Certificate in IT

October 2006

EXAMINERS' REPORT

Computer & Network Technology (formerly called Technology)

General Comments

Candidates' performance 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 11 and the least popular was question 8.

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 1

1. A computer is defined in terms of its Instruction Set Architecture (ISA) that describes its functional characteristics. A computer's ISA includes its register set, instruction set, and addressing modes.

Describe the instruction set architecture of a computer with which you are familiar. (You may describe a real microprocessor or a 'hypothetical teaching machine').

Your answer should also discuss instruction categories; for example, data movement, arithmetic, etc.

You are asked to describe the computer's register set, addressing modes and typical instructions. You are NOT asked to describe features such as speed, performance, I/O, buses, or memory management. **(30 marks)**

Answer Pointers

This is an open-ended question. Instead of asking students to write a program or to explain some specific aspect of a computer's architecture, they are asked to describe a computer architecture – any architecture.

A description that indicates that students understand what constitutes a computer architecture is being looked.

In particular, in order to get full/high marks students must cover three aspects of a computer architecture

1. The register set
2. The instruction set
3. The addressing modes.

The register set describes the type of registers implemented by a processor. For example, the Intel IA32 architecture has a rather complex set of special-purpose registers (different registers have specific functions). The 68K has a register set that is divided into address (pointer)

registers and data registers (general purpose use). Most RISCs have entirely general-purpose registers with no special-purpose registers.

Note that almost all processors have a program counter and processor status register.

A good answer would include references to how the processor deals with data elements smaller than the basic register size (some processors have 16- or 32-bit registers but also implement byte operations).

For example:

The 68K has 16 general-purpose registers. These are divided into 8 data registers D0 to D7 and eight address (pointer) registers A0 to A7. Data registers are entirely general and none have special purposes. Address registers are also general-purpose, although A7 is reserved as the system stack pointer. Data registers support byte, word and long word (32-bit) operations. Address register support only 32-bit operations (a 16-bit operations will be sign extended to 32 bits). Address registers take part in a limited number of data operations (addition, subtraction) because they are used only as pointers.

The **instruction set** describes the type of operations a computer can carry out. This should also include the instruction format (one address, two address, or three address – one address is of the form ADD A, two address ADD P,D0, three address ADD R0,R1,R2).

Students should briefly describe the instruction classes provided by a computer – data movement, arithmetic, logical, shift, program flow control (branch, conditional branch subroutine call and return). A good answer should give reference to the applications of instructions.

Addressing modes describe how an operand is accessed. There are three fundamental modes that are common to all processors – literal (the operand is a constant that is part of the instruction), absolute (the operand is specified by an absolute memory address), and pointer based (the operand is accessed by a pointer in a register or in memory. Processors often have several variations on these fundamental addressing modes such as auto incrementing.

Examiner's Comments

Most candidates attempting this question referred to the Von Neumann Architecture. Through this example, candidates attempted to describe the CPU and then explained the various components including Control Unit, Arithmetic and Logic Unit. Some candidates also included a diagram. Candidates who scored higher marks described in details register set, various addressing modes and also provided examples of typical instructions.

It was noted that many candidates made a brief attempt to cover the various issues. For example, a one line definition of addressing mode was not enough. Candidates should have described the various addressing modes in details.

The entire question was based on computer architecture. Candidates need to understand this area of computing. As this a traditional area, candidates need to be well prepared for future sittings.

Question 2

2. An alarm has four logical binary inputs A, B, C, and D. An input is 1 if the corresponding alarm is triggered. The alarm signals are:

A: temperature detector 1 (output 1 if hot)
B: flame detector (output 1 if flames detected)
C: temperature detector 2 (output 1 if hot)
D: smoke detector (output 1 if smoke detected)

The alarm provides a fire warning output under the following circumstances:

- If the outputs of both temperature detectors are true.
- If the output of the smoke detector is true and the output of one or both temperature detectors are true.
- If the output of the flame detector is true.

a) Draw a truth table to illustrate this problem. **(9 marks)**

b) From the truth table write down a Boolean expression for the alarm in terms of the four inputs A, B, C, and D. **(8 marks)**

c) By means of Boolean algebra or a Karnaugh map, create a simplified expression for the fire alarm output. **(7 marks)**

d) Using AND, OR and NOT gates design a suitable circuit for this alarm. **(6 marks)**

Answer Pointers

Part a)

A B C D	Alarm output F	
T F T S	0	
0 0 0 0	0	
0 0 0 1	0	
0 0 1 0	0	
0 0 1 1	1	Smoke 1 temp
0 1 0 0	1	Flame
0 1 0 1	1	Flame
0 1 1 0	1	Flame
0 1 1 1	1	Smoke, 1 temp
1 0 0 0	0	
1 0 0 1	1	Smoke, 1 temp
1 0 1 0	1	Both temp detectors
1 0 1 1	1	Both temp detectors
1 1 0 0	1	Flame
1 1 0 1	1	Smoke, 1 temp
1 1 1 0	1	Both temp detectors
1 1 1 1	1	Both temp detectors

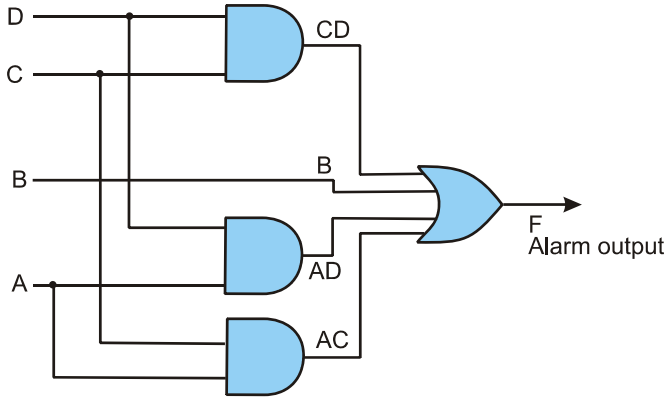
Part b
A Boolean expression for F is

$$F = \overline{A}.\overline{B}.C.D + A.\overline{B}.\overline{C}.\overline{D} + \overline{A}.B.C.\overline{D} + A.\overline{B}.\overline{C}.D + A.B.\overline{C}.\overline{D} + A.B.C.D +$$

$$A.\overline{B}.C.\overline{D} + \overline{A}.B.C.D + A.\overline{B}.\overline{C}.D + \overline{A}.B.C.D + \overline{A}.B.C.D + A.B.C.D$$

Part c
$F = B + C.D + A.D + A.C$

Part d



Examiner's Comments
Candidates who attempted this question managed to score well. This was due to marks well spread between the 4 parts of the question.

a) Most candidates were able to correctly produce the truth table. Maximum marks were awarded to candidates who also related the truth table to the four signals. It should be noted that candidates who did not score well in this question overall failed to produce a correct truth table.

b) Following the truth table, candidates tried to write a Boolean expression, which in most cases was incorrect. Few candidates were able to produce an expression based on the truth table, which should have been a straightforward task.

c) This part of the question was, in general, poorly attempted. Most candidates used Karnaugh map to create a simplified expression. However, they were unable to relate the expression produced in (b) to the Karnaugh map. If candidates had prepared this topic, they should been able to work through the various steps, producing the circuit diagram.

d) Very few candidates were able to produce a correct circuit diagram. Some candidates who attempted this part of the question did not base the diagram on the expression in c). Instead, they suggested a circuit based on an alternative logic.

Question 3

3. The microprocessor drove the personal computer revolution that began in the 1980s. In parallel with the revolution in personal computing, there have been revolutions in the fields of consumer electronics (digital cameras, camcorders, MP3 and personal audio) and communications (the cell phone, WiFi wireless networks, and the Internet/WWW).

A feature of today's world is the convergence between personal computing, communications, and personal entertainment systems. The distinction between computers, personal organizers, and cell phones is beginning to disappear as new devices are marketed that have features of personal computers, cell phones, and entertainment systems.

a) Provide a short history of the development of computers and communications systems, paying attention to the features that have made these systems so popular, portable, and widely available. **(20 marks)**

b) Discuss the ways in which you think that such devices will develop over the next two or three years as processing power increases, display devices become more sophisticated and consume less power, and communications systems continue to evolve. **(10 marks)**

Answer Pointers

Part a)

This is a very open-ended question. Evidence that the candidate is aware of developments in a range of related fields is being sought.

Candidates should be able to describe and summarize developments in recent computer history. In particular, students should appreciate that the PC has developed by: increasing power of the CPU (higher clock speeds and more components per chip) to provide today's high-level of computing power. The increase in computational paper has been driven by the need to process multimedia applications such as audio and video. In parallel with the increase in processing power, we have seen a reduction in the average power per transistor required by CPUs. Power reduction is necessary for personal, portable and ubiquitous computer applications. The answer should also cover the increase in the capacity of storage mechanisms such as disk drives and the growth in the use of media such as compact flash.

Personal communications systems once used relatively bulky and slow modems to connect to the switched telephone network. Today, the personal computer (and personal electronic systems) can use smaller and higher speed modems, broadband via the telephone network, cable or fibre optics, WiFi via wireless networks, and links via cell phones. These systems can be portable, provide reasonably high speed data links and operate from battery power.

Until recently, we have seen three distinct technologies used in three different personal devices. The PDA (personal organizer) is, effectively, a hand-held lap-top computer. That is, it has the characteristics of a very much cut-down personal computer – but it can run typical PC applications such as word-processing, database, and spreadsheet. The MP3 player is an extension of the personal stereo (based on tape or minidisk). The cell phone is an extension of the 'walkie-talkie' but has no real precursor because it is only very recently that technology has permitted the design of a light-weight two-way mobile wireless system.

The convergence of these technologies can be seen by the way in which the cell phone has incorporated technologies from both the computer and entertainment worlds. In particular, it is possible to extend the cell phone's display to incorporate some of the futures of the PDA. Equally, the use of CompactFlash memory makes it possible to transform the cell phone into a MP3 player. Finally, the development of low-cost optics and light sensors had made it possible to incorporate digital camera technology in the cell phone.

These technologies have paved the way for the development of multipurpose devices that incorporate many of the functions of cell phones, PDAs, MP3 players and digital cameras.

Part b)
This is also open ended.

This trend can be expected to continue. This is partially because of the pressures of competition and innovation but partially because of progress in the semiconductor industry that allows more processing power and data storage per chip. The development of organic light emitting diodes and more advanced battery technologies are also having and effect on this market. Even fuel cells (batteries running on alcohol) are beginning to make an appeared in mobile systems.

Examiner's Comments
This question was very popular among candidates.

a) Good answers included a detailed account of processors (including micro-processors). Some candidates also covered development in storage facilities, monitors and communication technologies. It was also noted that many candidates simply mentioned the examples (MP3, digital cameras, etc) that were given in the question. To obtain maximum marks candidates should explain how computers have developed in the past and how such development have impacted on devices which are classified as 'computer electronics'.

b) This part of the question was poorly attempted. Candidates seemed to be aware of increased processing power and low battery consumption but failed to explain these. It was also noted that some candidates emphasised too much on development in gadgets such as MP3 but did not suggest development in the computer field.

Question 4

4. Computers execute instructions in sequence unless the flow of control is modified by a branch (jump) instruction, or by a subroutine call or a subroutine return.

The flow of control is also modified by the interrupt (also called an *exception*). Interrupts may be divided into two broad classes; those that originate in hardware and those that originate in software.

a) Explain why interrupts (both hardware and software) have been implemented by most computers. **(8 marks)**

b) What is the role of *software interrupts* (also called *traps*)? **(7 marks)**

c) How are hardware interrupts used to implement input/output mechanisms? Describe the sequence of events that take place when a peripheral requests attention. **(8 marks)**

d) Some computers have a prioritized, vectored interrupt-driven input/output system. What do we mean by the terms *prioritized* and *vectored* in the context of interrupts? **(7 marks)**

Part a
An interrupt or exception allows a computer to respond to an event that could not be dealt with when the program was written. Hardware or external interrupts are used to indicate that attention is required at the hardware level; for example, a disk drive may indicate that it is ready to take part in a data transfer, a memory device may indicate that an error has occurred, or a bus may indicate that a transaction cannot be completed, or that a page fault has been signalled by a memory management unit. Without hardware interrupts, it would be difficult to respond to peripherals or to errors in the system hardware.

Software interrupts (exceptions) are used to either call an operating system function or to recover from certain classes of programming error that would, otherwise, cause the system to crash.

Part b
Software interrupts fall into two categories. Those that are implemented by the programmer (this is a case where the programmer deliberately inserts a software interrupt such as a TRAP into the program) are usually operating system calls. Such an interrupt forces the operating system to intervene to carry out some function such as I/O or a disk transaction.
Software exceptions not implemented by the programmer are caused by errors that have to be dealt with by the operating system. For example, dividing a number by zero may cause a software exception because the result is infinity and indicates that an error has occurred. Similarly, attempting to execute an illegal opcode causes an exception because either the code has been corrupted or a jump has been made to a region of data.

Part c
Typically, a peripheral asserts an interrupt request line that indicates its need for attention. The processor then waits for the end of the current instruction before responding to the interrupt request. Instructions cannot (in general) be interrupted before they have been completed.

The processor checks whether the interrupt can be processed (see next answer for details). If the interrupt can be processed, the current status (condition code register and flag bits) and program counter are saved on the stack. A jump is made to the interrupt handling routine and the cause of the interrupt dealt with. Finally the processor status is retrieved from the stack and the program counter loaded with the return address.

Part d
Some systems have multiple I/O devices and other systems that generate interrupts. It is necessary to implement a means of ensuring that the 'right' device gets access to the interrupt handling mechanism. Prioritization allows the interrupts to be arranged so that a high priority device will always get attention if it is competing with a low priority device. Generally, a device with a high priority interrupt may interrupt the processor even if it is already processing the interrupt of a low-priority device.

The 68K microprocessor uses an external prioritiser (supplied by the systems designer). Up to 7 interrupt request input are fed into a device that generates the code of the interrupt with the highest priority. This code is received by the computer which responds to the interrupt if the computer is not executing an interrupt handling procedure at a lower level (note that the current interrupt level is recorded by the bits of the status register).

The processor may deal with interrupt handling by jumping to a location in memory and then reading each peripheral until the interrupter has been located. This polling mechanism is slow. In a prioritized interrupt handling system, the processor acknowledges an interrupt by putting the interrupt level on the data/address/interrupt bus. The interrupter then supplies a key to the processor and this key is used to index into a table of interrupt handling routine addresses. This process speeds up interrupt handling.

Examiner's Comments
Topics examined in this question appeared during previous sittings. If candidates had paid more attention to such traditional areas of computing, they could have scored high marks. Candidates must ensure that they fully understand how instructions are handled by the processor. Candidates must be aware of controls within the CPU.

a) Candidates were not fully aware what interrupts are. Answers were short and unclear. Candidates needed to explain that an interrupt allows a computer to respond to an event that could not be dealt with when a program was written. For higher marks, candidates should have explained that external interrupts are used to indicate that attention is required at the hardware level.

b) Candidates showed little knowledge of software interrupts. A software interrupt could be implemented by the programmer, where a TRAP is deliberately inserted into the program. In addition software interrupts can also be caused by errors that have to be dealt by an operating system.

c) Candidates were expected to explain the sequence of events that take place when a peripheral requests attention. Most candidates made a fair attempt to provide an answer and manage to raise relevant events although not all and in the right sequence.

d) Few candidates were able to explain 'prioritised interrupts'. Candidates seemed to have ignored this area when studying for interrupts. A reasonable answer for prioritised interrupt would have been to raise issues around how interrupts are arranged so that a high priority device gets attention if it is competing with a low priority device.

Question 5

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

a) Using examples, describe and explain the function and importance of a web browser. **(6 marks)**

b) SPAM can seriously affect internet users. Explain what SPAM is. Describe how users can protect themselves against SPAM. **(6 marks)**

In addition to wasting people's time with unwanted e-mail, SPAM also eats up a lot of network bandwidth. Because the internet is public, there is really little that can be done to prevent spam, just as it is impossible to prevent junk mail. However, some online services have instituted policies to prevent spammers from spamming their subscribers.

Examiner's Comments

This question was attempted reasonably well by candidates. Most candidates attempting this question were able to obtain a pass mark.

a) The purpose of the question was to test candidates' ability to understand how internet is accessed through a web browser. It was noted that many candidates confused a web browser to a search engine (Google, Yahoo, etc). Correct answers provided examples of Internet Explorer and similar browsers. Answers should have focused on displaying text, graphics, sound and video.

b) Candidates were able to discuss various issues around SPAM and how to protect against it. Good answers needed coverage of issues around SPAM included junk email as a nuisance, eating up network bandwidth and filling email boxes with unnecessary data. Candidates were also able to suggest suitable methods to deal with SPAM.

Question 6

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

a) local area network and wide area network **(6 marks)**

b) FTP and SMTP **(6 marks)**

Part a

LAN - A computer network that spans over a relatively small area. Most LANS are confined to a single building or group of buildings. Most LANs connect workstations and personal computers. Each node (individual computer) in a LAN has its own CPU with which it executes programs, but it also is able to access data and devices anywhere on the LAN. This means that many users can share expensive devices, such as laser printers, as well as data. Users can also use the LAN to communicate with each other, by sending e-mail or engaging in chat sessions.

WAN - A computer network that spans a relatively large geographical area. Typically, a WAN consists of two or more LANs. Computers connected to a WAN are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites.

b) FTP and SMTP

FTP - short for File Transfer Protocol, the protocol for exchanging files over the internet. FTP works in the same way as HTTP for transferring Web pages from a server to a user's browser. FTP uses the internet's TCP/IP protocols to enable data transfer.

FTP is most commonly used to download a file from a server using the Internet or to upload a file to a server (e.g., uploading a Web page file to a server).

SMTP - short for Simple Mail Transfer Protocol, a protocol for sending email messages between servers. Most email systems that send mail over the internet use SMTP to send messages from one server to another; the messages can then be retrieved with an email client. In addition, SMTP is generally used to send messages from a mail client to a mail server.

Examiner's Comments

a) Candidates were able to differentiate between LAN and WAN. Answers included issues distance, ownership, speed of data transfer and cost. Some candidates also included diagrams which made the description of the networks easier.

b) Candidates were unable to clearly differentiate between FTP and SMTP. Answers were very brief and candidates failed to score the 6 marks allocated. Good answers on FTP should have included issues around exchanging of files over the internet as well as reference to TCP/IP. In the case of SMTP, candidates should have explained the importance of sending and retrieving messages by servers. A brief description of the interaction between the email client and server was required.

Question 7

7. *a)* Briefly outline the stages of the compilation process. Include in your answer the purpose of each stage. **(9 marks)**

b) What is the difference between a *compiler* and an *interpreter*? **(3 marks)**

a) Looking for understanding of lexical analysis, syntax analysis, code generation; why are they needed, what they produce, etc. Allocate a couple of marks for those that mention code optimization and also give examples.

b) Standard bookwork answer is required.

Examiner's Comments

a) Candidates were unclear about the compilation process. Most candidates limited themselves to describing what a compiler does. Answers should have included clear explanations of lexical analysis, syntax analysis and code generation. In addition, candidates should have included issues around code optimisation in their answers.

b) Most candidates were able to differentiate between a compiler and an interpreter. Answers were however short and lacked depth.

Question 8

8. Optical scanners are extensively used today for scanning a wide range of data. Describe the operation of an optical scanner. Explain the main characteristics of the scanner and how they contribute to its use. **(12 marks)**

An optical scanner is a device that can read text or illustrations printed on paper and translate the information into a form the computer can use. A scanner works by digitising an image -- dividing it into a grid of boxes and representing each box with either a zero or a one, depending on whether the box is filled in. (For colour and grey scaling, the same principle applies, but each box is then represented by up to 24 bits.) The resulting matrix of bits, called a bit map, can then be stored in a file, displayed on a screen, and manipulated by programs.
Optical scanners do not distinguish text from illustrations; they represent all images as bit maps. Therefore, you cannot directly edit text that has been scanned. To edit text read by an optical scanner, you need an optical character recognition (OCR) system to translate the image into ASCII characters. Most optical scanners sold today come with OCR packages.

A range of scanners are available: flat bed scanners or hand held scanners. The latter scanners are commonly used in the retail trade (shops and supermarkets) or libraries to read barcodes.

Examiner's Comments

This question was very unpopular among candidates. Those who attempted the question were not clear about how scanners operate.

A reasonable answer for this question would have been a brief description of how optical scanners function including the reading of text or illustrations from paper. Candidates would also need to explain how images are digitised and converted into bit map which is then stored in a file. For higher marks, candidates also needed to explain that an Optical Character Recognition (OCR) system is needed to translate images into ASCII characters.

Question 9

9. With the help of a block diagram, show and briefly explain the internal components of the Central Processing Unit of a digital computer. **(12 marks)**

The diagram must consist of the following components:

- The CPU, Control Unit, Arithmetic and Logic Unit (ALU)
- Registers (PC, MAR, MBR)
- Buses (data and instruction)
- Flows showing how all the components are inter-connected to one another.

A brief description of the above must be available.

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.

Good answers included the benefits as well as the drawbacks. Maximum marks could have been scored if candidates had argued that internet threats such as SPAM and internet fraud can seriously affect e-commerce.

Question 10

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

a) Direct Memory Access (DMA)
b) Virtual memory
c) Cache memory **(3 x 4 marks)**

a) A signal informing a program that an event has occurred. When a program receives an interrupt signal, it takes a specified action (which can be to ignore the signal). Interrupt signals can cause a program to suspend itself temporarily to service the interrupt. Interrupt signals can come from a variety of sources. For example, every keystroke generates an interrupt signal. Interrupts can also be generated by other devices, such as a printer, to indicate that some event has occurred. These are called hardware interrupts. Interrupt signals initiated by programs are called software interrupts. Each type of software interrupt is associated with an *interrupt handler* -- a routine that takes control when the interrupt occurs. For example, when you press a key on your keyboard, this triggers a specific interrupt handler.

b) Virtual memory is an imaginary memory area supported by some operating systems (for example, MS Windows) in conjunction with the hardware. You can think of virtual memory as an alternate set of memory addresses. Programs use these *virtual addresses* rather than real addresses to store instructions and data. When the program is actually executed, the virtual addresses are converted into real memory addresses. The purpose of virtual memory is to enlarge the address, 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) 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.

Examiner's Comments
Candidates attempted this question reasonably well. Answers although short were relevant. Candidates managed to differentiate virtual and cache memory.

Question 11

11. Operating Systems support full Graphical User Interface (GUI) environments. Explain each of the following terms as applied to GUI:

a) pointer
b) windows
c) menu
d) desktop
e) shortcut
f) task bar **(6 x 2 marks)**

a) pointer - A symbol that appears on the screen and that you move to select objects and commands. Usually, the pointer appears as a small angled arrow.

b) windows - You can divide the screen into different areas. In each window, you can run a different program or display a different file. You can move windows around the display screen, and change their shape and size at will.

c) menu - Most graphical user interfaces let you execute commands by selecting a choice from a menu.

d) desktop - The area on the display screen where icons are grouped is often referred to as the desktop because the icons are intended to represent real objects on a real desktop.

e) shortcut - a picture that appears on the desktop which is used to run a command or application. Each shortcut is associated with a path, which defines the location of the application which needs execution.

f) taskbar - main control centre that enable launch a range of tasks on the computer. In Microsoft Windows, the task bar prompts the user to 'Start' using the computer.

Examiner's Comments
This was a straightforward question which many candidates attempted well. Candidates showed a good understanding of Graphical User Environment with reference to Microsoft Windows ^{TM}. Most candidates managed to score high marks for this question.

Question 12

12. *a)* What is a DSL Internet Connection? **(6 marks)**

b) In the context of network security, describe the use of a *packet filter* and *proxy server* as used in a firewall. **(6 marks)**

a) DSL short for Digital Subscriber Lines uses a sophisticated modulation scheme to pack data onto copper wires. DSL is sometimes referred to as a *last-mile technology* because it is used only for connections from a telephone switching station to a home or office, not used between switching stations. DSL is also called an *always on connection* because it uses existing 2-wire copper telephone line connected to the premise and will not tie up your phone as a dial-up connection does. There is no need to dial in to your ISP as DSL is always on. The two main categories of DSL for home subscribers are called ADSL and SDSL.

ADSL: Asymmetric Digital Subscriber Line: supports data rates of from 1.5 to 9 Mbps when receiving data (known as the downstream rate) and from 16 to 640 Kbps when sending data (known as the upstream rate). ADSL requires a special ADSL modem.

SDSL**:** S*ymmetric Digital Subscriber* ***l****ine*, a technology that allows more data to be sent over existing copper telephone lines. SDSL supports data rates up to 3 Mbps. SDSL works by sending digital pulses in the high-frequency area of telephone wires and can not operate simultaneously with voice connections over the same wires. SDSL requires a special SDSL modem. SDSL is called symmetric because it supports the same data rates for upstream and downstream traffic.

b) A firewall can be seen as a system designed to prevent unauthorized access to or from a private network. Firewalls can be implemented in both hardware and software, or a combination of both. Different techniques are used for firewalls:

Packet filter**:** Looks at each packet entering or leaving the network and accepts or rejects it based on user-defined rules. Packet filtering is fairly effective and transparent to users, but it is difficult to configure. In addition, it is susceptible to IP Spoofing

Proxy server**:** Intercepts all messages entering and leaving the network. The proxy server effectively hides the true network addresses.

Examiner's Comments

a) In answering this question, candidates used their own personal exposure to the DSL. Many questions mentioned broadband communication and provided some of the features. However, answers were brief and inaccurate, hence the inability for candidates to score maximum marks. Good answers should have described that the '*always on connection*' and how DSL will not tie up the phone compared to dial-up connection.

b) Most candidates were able to describe the importance of network security. Answers included good coverage of packet filter and proxy servers.