

**BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 4 Certificate in IT**

October 2010

EXAMINERS' REPORT

Computer Network Technology

Overall comments

Many centres ignored comments made in previous reports in following instructions on completing the front of the scripts. It is important for candidates to indicate which questions they attempted. Candidates failed to write the question number at the top of every page of the scripts. Centres and course providers must impress this rule on their candidates as omission of vital information causes problems during marking. The level of English was bad in some centres, hence the inability for candidates to express themselves clearly. It was also noted that some candidates used red ink. This should not be used since it conflicts with marking of scripts.

While marking scripts, it was felt that candidates did not seem to have studied the various topics well in some centres. Course providers must endeavour to explore this syllabus in depth. Computer and Network Technology is a core aspect of an IT Professional. Gaps in knowledge with regards to this area can pose serious problems in understanding more advanced and specialist IT concepts. If in doubt, course providers must seek clarification from the BCS examinations' office.

In some centres, many candidates did not attempt the correct number of questions. Consequently, they were not able to score enough marks to achieve a pass grade.

The most popular question was 10 and the least popular was 4.

Detailed questions' report

As in previous sittings, 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. It is also worth mentioning that candidates seemed to ignore the amount of marks allocated to questions in section A and B. When writing answers, candidates must carefully keep in mind that questions 1, 2, 3 and 4 carries 30 marks. Accordingly, candidates must write sufficiently in-depth answers to attract these marks. Short answers which lack depth did not enable candidates to score well in section A.

Below are suggested answer points to each question.

Section A

Question A1

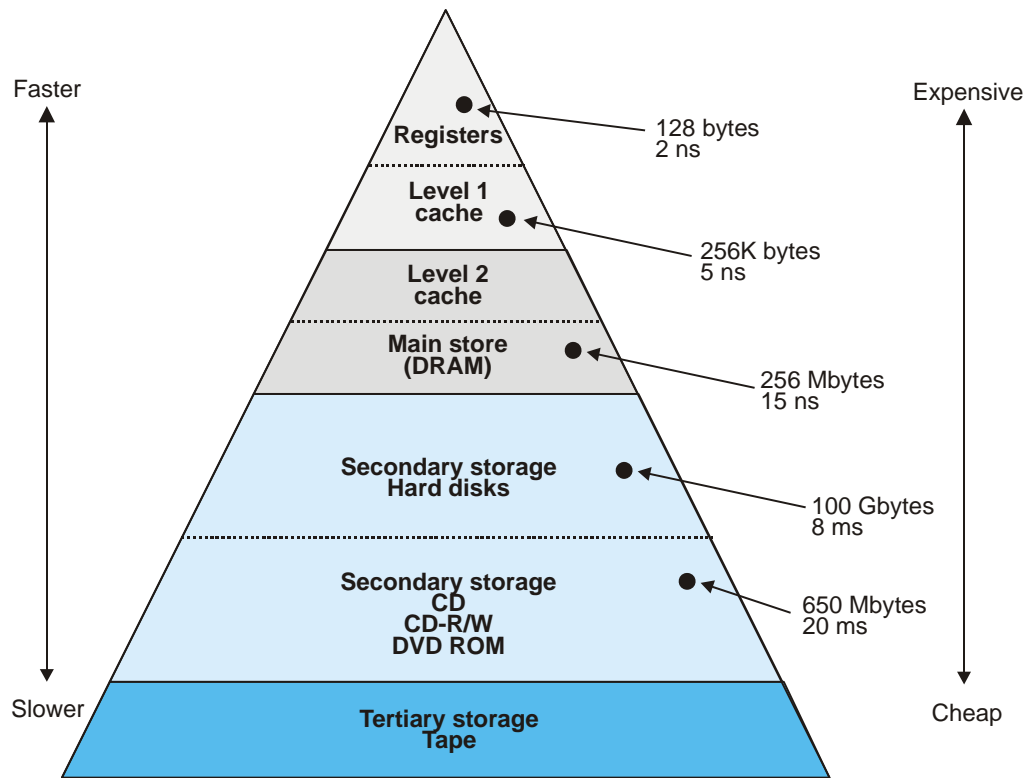
A digital computer is said to have a memory hierarchy (i.e., it uses several forms of storage device/mechanism to hold data and each storage device has different characteristics).

- a) Explain why such a memory hierarchy exists.
(6 marks)
- b) Draw a diagram to represent the memory hierarchy you might expect to find in a typical high-performance personal computer. Start with the CPU's internal registers that sit at the top of the hierarchy.
(6 marks)
- c) Describe the characteristics (operating parameters, relative cost, and performance) of the elements of the memory hierarchy.
(18 marks)

Answer Pointers

- a) Ideally, all computer memory should be fast (access time low so that the CPU can read data without having to slow down), cheap, non-volatile (retain data without power), high density (the memory elements should store large quantities of data and use little energy (i.e., low power consumption prolongs the life of the computer, saves energy, and make portable computing possible). No real memory has all these attributes. However, by means of memory management techniques it is possible to use several different types of memory in a computer and obtain a performance close to the ideal of fast, cheap, non-volatile memory.

The key point in this answer is that students should appreciate that different memories have different properties – in particular speed, density, and volatility, and that different types of memory can be combined to overcome the limitation of individual technologies.



Question A2

- a) An assembly language instruction may use one of several **addressing modes** to specify the operand. Explain the meaning of **addressing mode** and give examples of three different types of addressing mode.

(8 marks)

- b) A computer stores 16 eight-bit unsigned integers in memory sequentially starting at location 1000_{16} .

Write a program in assembly language to determine the largest integer in the list. When the program terminates the largest value should be stored in the location following the end of the list of 16 data elements. You may use any assembly language to write this program. However, you must (i) carefully explain what your program does and how it works, (ii) define what each of your instructions does, and (iii) fully document your code.

(22 marks)

Answer Pointers

- a) An addressing mode in assembly language indicates the way in which an operand used by an instruction is accessed; for example, `ADD D0,1000` in 68K assembly language means add the contents of memory location 1000 to register D0. The value 1000 represents an addressing mode in which the address (location) of an operand in memory is specified.

There are many different addressing modes, although all of them are variations of three basic modes. These are:

LITERAL This is also called immediate addressing. In this addressing mode the actual value of the operand is specified in the instruction. For example, the instruction `ADD #24,D3` means add the actual value 24 to the contents of register D3. This addressing mode is used to set up constants that are known at compile time such as the number of times round a loop.

ABSOLUTE This is also called direct addressing. Here, the location of the operand in memory is specified; for example, `MOVE D0,2000` means move the contents of register D0 to memory location 2000. Normally, symbolic names would be used; for example `ADD D2,New` means add the contents of D2 to the contents of the memory location known as 'New'. This addressing mode is used to deal with variables (i.e., operands whose value can change or be altered as the program runs – unlike literal values (constants)).

REGISTER INDIRECT This addressing mode has a wide range of alternative names such as indexed addressing. However, the important point is that the address of an operand is given by the contents of a register; for example `ADD (A2),D1` which means add the contents of the memory location whose address is in register A2 to D1. Since the address is specified in terms of the contents of a register – and the contents of registers can be changed – it follows that this addressing mode allows a variable address. Consequently, you can use register indirect addressing to support data structures such as tables, lists, and arrays. In real machines, a register indirect address is specified as the contents of a register plus a constant – for example, `MOVE #4,(12,A1)` where the destination address is the memory location is given by the contents of A1 plus the value 12. This is also called pointer based addressing.

c) Design the program in some minimal way before coding it; for example,

Point to first location at 1000_{16}

Set maximum value to 0

LOOP

Read element

IF element > maximum THEN maximum = element

UNTIL all 16 elements read

Store maximum at 1010_{16}

In order to implement this algorithm it will be necessary to use pointer based addressing.

Using simple 68K code, we can write:

<code>MOVE #\$1000,A0</code>	Address register A0 points to location 1000_{16}
<code>MOVE.B #0,D0</code>	Data register D0 is maximum and is initially set to zero
Loop <code>MOVE.B (A0),D1</code>	Read element into D1
<code>ADD #1,A0</code>	Increment pointer in A0
<code>CMP.B D1,D0</code>	Compare current with previous maximum
<code>BLT Next</code>	If less than maximum continue round loop
<code>MOVE.B D1,D0</code>	If greater than maximum then save new maximum
Next <code>CMP.B #\$1010,A0</code>	Have we done all 16?
<code>BNE Loop</code>	If not then continue
<code>MOVE.B D0,\$1010</code>	If finished then save result

Question A3

a) Peripherals such as printers can be connected to a computer by either a USB link or by means of wireless (WiFi). Briefly describe the characteristics of USB and WiFi links in the context of interfaces and comment on their suitability as a means of linking peripherals to a computer.

(15 marks)

b) Describe any modern computer peripheral (excluding simple devices such as the keyboard and mouse). You must describe the principles of operation, and characteristics of the peripheral.

(15 marks)

Answer Pointers

a) The USB (universal serial bus) provides a physical wired connection between a PC and a peripheral. USB now replaces the older serial and parallel interfaces once found in PCs. USB is inexpensive and fast (initially up to 12 Mbits/s and up to 480 Mbits/s in the new USB 3.0 version).

You can connect a peripheral between the computer (host) and a device such as a mouse, keyboard, printer, scanner, disk drive, pen drive, OR you can connect a USB plug to a hub and the hub can connect to several other peripherals or even hub; that is, the USB interface allows multiple devices to be connected to it (but they have to share the same bandwidth).

Because the USB cable carries both data and power, many devices get their power from the USB connection and it has now become a means of charging cell phones and MP3 players. Moreover, low power devices such as small hard drives can be powered entirely from USB.

USB also supports 'plug and play'. This means that a new device can communicate with the PC and provide its own device drivers – removing many of the problems of locating and loading a device driver for a new peripheral.

WiFi is a wireless-based local area network based on the IEEE 802.11 standards. Originally, WiFi was used to link computers. Today, it is used to link computers, laptops, video consoles, MP3 players, smartphones, printers, and even disk drives.

In many ways, WiFi performs a similar role to USB by linking together modern electronic devices.

WiFi now plays an important role in mobile computing. Many public areas (stores, hotels, libraries and public buildings, restaurants, airports, and even trains) have so-called WiFi hot spots where WiFi-enabled devices may be used – often without payment. The main use of WiFi away from the home/office is to access the internet for browsing, email, and downloading programs/data/multimedia.

A disadvantage/danger of WiFi is that it is potentially open to eavesdropping (although it is possible to use secure encryption modes. The range of WiFi is typically 32m indoors. However, by means of directional antennas ranges of several kilometres are possible. Modern versions of WiFi permit speeds of 54Mbps and 108 Mbps. A potential problem is that the growth in the use of WiFi may create bottlenecks as the radio spectrum allocated to WiFi is limited.

The principal properties/characteristics of a scanner are :

- Type (drum, flatbed, handheld)
- Media size (e.g., up to A4 paper for a flatbed scanner).
- Resolution (the number of dots/pixels per inch in both the x and y axes)
- Speed (time to scan a document)
- Interface (connection to the host computer – SCSI, parallel, serial, USB, wireless)
- Physical parameters (weight, physical dimensions, power consumption, noise level)

Question A4

- a) What are the fundamental differences between combinational logic elements (such as an AND gate), and sequential elements such as a flip-flop?
(6 marks)
- b) How are sequential logic elements used in a digital computer? Describe three roles they may perform in a digital computer.
(9 marks)
- c) Show, by means of a circuit diagram, how several flip-flops can be used to create a binary counter that counts from 0 to 7.
(9 marks)
- d) For the circuit you constructed in part (c) provide a timing diagram for your counter that shows how it counts up through the sequence 0,1, ...7, 0, 1, 2, 3, ...
(6 marks)

Answer Pointers

a) A gate is a combinational logic element whose output is determined by the current value of the input(s) and the nature of the gate (AND, OR, NOT etc). Thus, if you know the input signals you can always calculate the value of the output.

A sequential element may be constructed from combinatorial elements but its output is a function of BOTH its current inputs AND its previous state. That is, you cannot determine the output of a sequential element only from a knowledge of its circuit and its inputs – you need to know its internal state or history. A sequential element has the property of memory (it remembers past events). Some sequential elements are clocked; that is, they change state only when a clock pulse is applied.

b) Sequential elements are able to store information and are therefore found in systems where changes of state take place; for example:

COUNTERS

A counter uses sequential elements to generate a sequence of numbers – the next number is generated at each clock pulse and remains stable until the next clock pulse. A counter may count up sequentially, 0,1,2, ... or down ...4,3,3,... or it may generate any repeating arbitrary sequence. A counter with n sequential elements (flip flops or bistables) can count through a maximum of 2^n states.

SHIFT REGISTERS

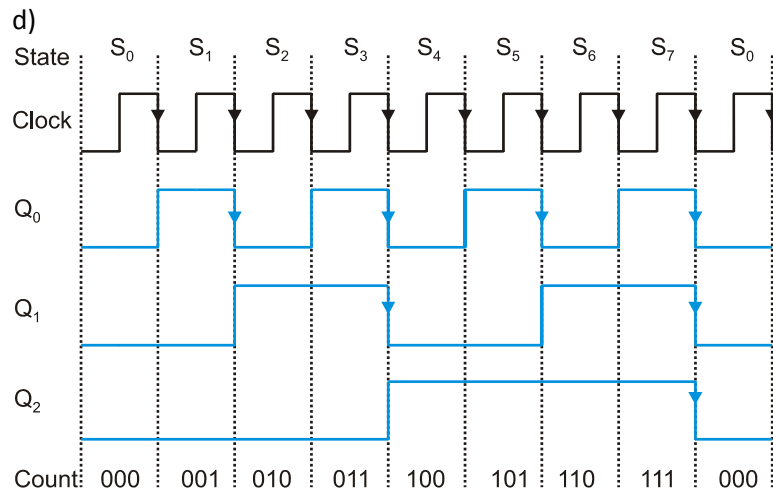
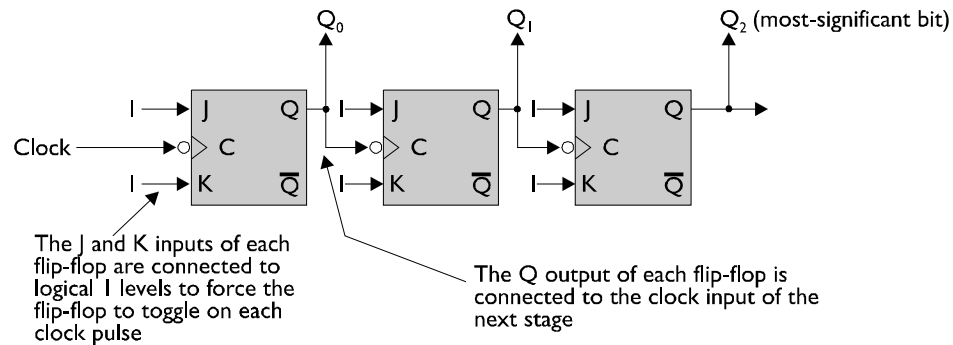
A shift register is normally the same width as a computer word. If the word width is m bits, the shift register holds m bits. When clocked, the shift register moves the bits one (or more) places left or right. Arithmetically, this is equivalent to multiplying the number by 2 or dividing it by 2 (if the number is an integer). There are different types of shift depending on what happens to the bit shifted out at one end and shifted in at the other – logical, arithmetic (sign of 2s complement numbers preserved), circular (the bit shifted out at one end is shifted in at the other end). Shift registers are used to manipulate bits in a word – for example – to move bits between different fields within a register/word.

REGISTERS

A register is just a set of m flip-flops and is used as an m -bit store to hold temporary data.

c) The following diagram shows a 3-bit up counter. It uses JK flip flops with their J,K inputs connects to logical 1 which causes them to change state at each clock. Note that the JK flip flop clock inputs are connected to the Q output of the previous stage and the clock inputs are negative edge triggered. (If the clocks are positive edge triggered then the connection must be to the NOT Q output of the previous stage).

NOTE – there are alternative designs of counter. Full credit will be given to any other design.



Section B

Question B5

- a) Describe the various malware threats faced by computer users. (6 marks)
- b) Recommend suitable measures to protect against these threats. (6 marks)

Answer Pointers

A coverage of :

- i) Virus
- ii) Trojan
- iii) SPAM
- iv) Spyware

Suitable protective measures e.g. antivirus software, spam filter, etc recommended to protect from each threat.

Question B6

- a) Describe the purpose of a router in a network. (6 marks)
- b) Explain how you can configure a router to improve traffic flow in the network. (6 marks)

Answer Pointers

(a) Router - 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.

Routers use headers and forwarding tables to determine the best path for forwarding the packets, and they use protocols such as ICMP to communicate with each other and configure the best route between any two hosts.

(b) Router configuration – ensure that data packets are 'routed' to the correct destination with minimum loss and disruption. Use of proper router commands and control lists (e.g. Cisco routers).

Question B7

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

- a) Bluetooth technology (6 marks)
- b) GPS (6 marks)

Answer Pointers

Simple definitions of each of the terms and how each is used in day to day activities. Definitions can be found in a variety of textbooks or on the web.

Question B8

Many people would state that the most important software in a computer is its operating system.

- a) Using examples, briefly describe the main functions of an operating system. **(8 marks)**
- b) Comment on recent developments in the field of operating systems. **(4 marks)**

Answer Pointers

(a) Main functions include :

- (i) Memory management
- (ii) Resource allocation
- (iii) Scheduling ... and others

(b) Reference to Microsoft based OS (e.g. Windows XP/7) and examples of developments.

Question B9

- a) Explain the function of a web browser. **(6 marks)**
- b) What are the differences between HTML and HTTP? **(6 marks)**

Answer Pointers

(a) A web browser is software used to locate and display Web pages. The two most popular browsers are Netscape Navigator and Internet Explorer. Both of these are *graphical browsers*, which means that they can display graphics as well as text. In addition, most modern browsers can present multimedia information, including sound and video, though they require plug-ins for some formats.

(b) HTML – Hypertext Markup Language used for creating websites

HTTP – Hypertext Transfer Protocol. Short for HyperText Transfer Protocol, 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.

Question B10

Explain how and when each of the following storage devices are used.

- a) Hard disc **(3 marks)**
- b) USB pen drive **(3 marks)**
- c) CD ROM **(3 marks)**
- d) Magnetic cartridge **(3 marks)**

Answer Pointers

Coverage of the technical features of each of the storage mediums. Issues such as amount of data that could be stored and speed of storage also need to be discussed.

- (a) Hard disc – e.g. as used on a PC (store all software and operational data files)
- (b) USB 'pen disc' – e.g. used to carry files around; can also be seen as a backup device for small amount of data.
- (c) CD ROM – used to store large amount of data for reference only; e.g. in libraries, etc
- (d) Magnetic cartridge – used for major backups.

Question B11

Accessing the Internet can prove frustrating to some users because there are many hardware devices and software packages available. Write a short report outlining the issues to be addressed when you wish to access the Internet. Consider both the cases of the fixed base (home or office) user and the mobile user.

(12 marks)

Answer Pointers

Issues to be covered :

- Availability of a computer with appropriate software
- Availability of telephone connection
- Need for the services of an ISP (including typical packages offered)
- Broadband or dial up connection
- Web browsing software e.g. Internet Explorer together with Search Engine (e.g.

Question B12

Briefly, explain the following processor related terms.

a) Instruction set

(4 marks)

b) Clock speed

(4 marks)

c) Bandwidth

(4 marks)

Answer Pointers

Three basic characteristics differentiate microprocessors:

- (a) instruction set: The set of instructions that the microprocessor can execute.
- (b) clock speed : Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.
- (c) bandwidth : The number of bits processed in a single instruction