BCS HIGHER EDUCATION QUALIFICATIONS
Level 4 Certificate in IT
September 2014
EXAMINERS' REPORT
Computer and Network Technology

General comments on candidates' performance

The standard of attempts has declined during this sitting. As in previous sittings, many candidates did not write sufficiently in-depth answers for 30 marks awarded for section A. Candidates attempted section B questions well. Centres must provide guidance and support to candidates so that they are prepared to write sufficiently in depth answers in section A. The most popular question was 9 and the least popular was 8.

Section A

A1

Answer Pointers

a)
All computers provide register indirect addressing; for example the 68K implements MOVE D1,(A2) and the ARM LDR r1,[r2]. In each case the address of the operand is given by the contents of a register (indicated by round brackets for the 68K and square brackets for ARM). Since, the contents of a register are a variable (they can be changed), the address is also a variable. This addressing mode provides a variable address that can be used to step sequentially through data structures like lists, tables, arrays, vectors.
In register transfer language, the effect of LDR r1,[r2] is [r1] ← [[r2]] which means that the contents of the memory location pointed at by r2 is loaded into register r1. Register-based addressing allows the address of an operand to be computed at run-time.

b)
Candidates were expected to demonstrate a basic knowledge of an (any) assembly language. They were not being tested on the details of syntax and were expected to understand how a simple problem is solved and (in this case) how register-based addressing is used to access a table and how test and branch instruction are used to implement if constructs.

```
First  DC 1,4,2,7,8,2,9,3,4,5 //this is the data structure
       ADR   First,r0         //load the address of the list into register r0
       MOV   #0,r1            //set up an initial dummy highest value in r1
       MOV   #10,r2           //We how 10 numbers and will count down
Next   LDR   r3,[r0]          //Get a number from the list and put it in r3
       CMP   r3,r0            //compare new number with the previous largest
       BLE   Less             //if less than then continue in loop
       MOV   r3,r0            //if greater than then save it in r0
Less   ADD   #4,[r0]          //increment pointer to point to next number
       ADD   #1,r2            //increment the number count
       CMP   #10,r2           //Have we done 10 yet
       BNE   Next             //If not all done then repeat
                              //Else fall through to here
```

Examiners' comments

This question was not well attempted. Candidates did not show a good understanding of addressing mode. Those who attempted this question were unable to produce an assembly language program . Some candidates used a high level language to write the program. Candidates should be able to write brief statements in a low level language.

A2

Answer Pointers

a)
Combinational logic elements are called gates. The three fundamental gates are AND, OR and NOT gates. ALL combinational digital circuits can be constructed from these gates. Indeed, since an OR can be made from NAND gates alone, then all combinational circuits can be made from NAND gates – no matter how complex.

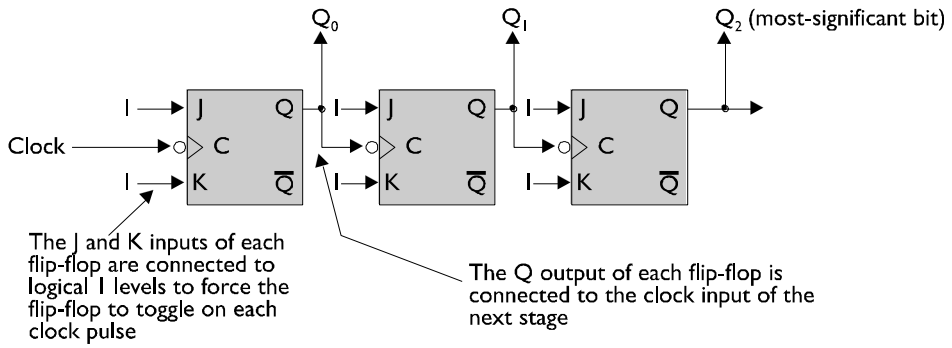
The output of a combinational circuit is a function only of its inputs. Its output does not change with time (i.e., it does not depend on any previous state or history). A combinational circuit can create any logical function; for example, you could build an arithmetic circuit to add A and B or to find sin(x). Similarly, you could build a circuit to find the maximum of number of inputs in a single operation.

Flip-flops and sequential circuits have memory; that is, their next output depends on their current state and their new inputs. These circuits are used to store data, shift data left and right, and to count. Basic sequential elements are D flip-flops, RS flip-flops and JK flip-flops.

By combining sequential with combinational elements any digital circuit can be built; for example the computer. Typically, a computer uses sequential elements to store data and temporary values and to step through instructions in memory, and it uses combinational logic to process the data from memory and to perform conditional tests.

b)
(i) A counter is a circuit that steps through a pre-arranged sequence of values cyclically; for example, a counter could generate 5,4,3,2,8,7,0,5,4… However, in normal usage we mean that a counter counts the natural sequence of numbers 0,1,2,3,4… Counters are used to sequence systems through stages (e.g., a washing machine going through cleaning cycles). In a computer, the program counter is an example of a counter stepping through the instructions of a program.

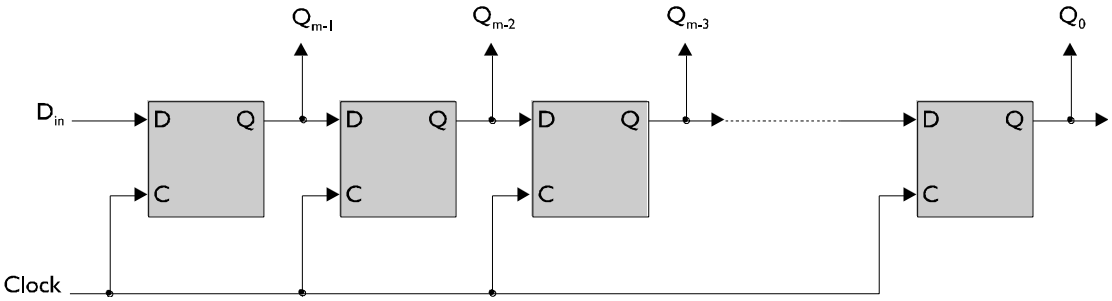
There are many ways of constructing counters (using both asynchronous and synchronous circuits). However, the simplest binary ripple-through up counter can be constructed from a chain of negative-edge-triggered JK flip-flops with their J.K inputs wired to a logical 1 which ensures that they change state on each falling edge of the clock. See below.



(ii) A shift register is a circuit that stores a sequence of bits in a register and is able to shift them one or more places left or right. For example, if a register holds the sequence 00111010, shifting one place left results in 01110100 and shifting it one place right results in 00011101.

Practical shift registers are complicated by their ends because there are three basic types of shift (arithmetic, logical, circular). The type of shift determines what happens to the bit shifted in and to the bit shifted out.

Shift registers are used to manipulate bits (change their order), divide numbers by 2 or to multiply them by 2. Shift registers can be made from D, or JK flip-flops. Below is a shift-right register constructed from D flip-flops. In order to shift left, the Q output of one stage must be routed to the D input of the stage to the left.



Examiners' comments

This question was not well attempted. Candidates did not show a good understanding of the difference between combinational logic elements and sequential elements. Those who attempted this question were unable to clearly show how flip flops can be used to construct a counter and a register. Some candidates merely provided diagrams and truth tables of logic gates as an answer to this question.

A3

Answer Pointers

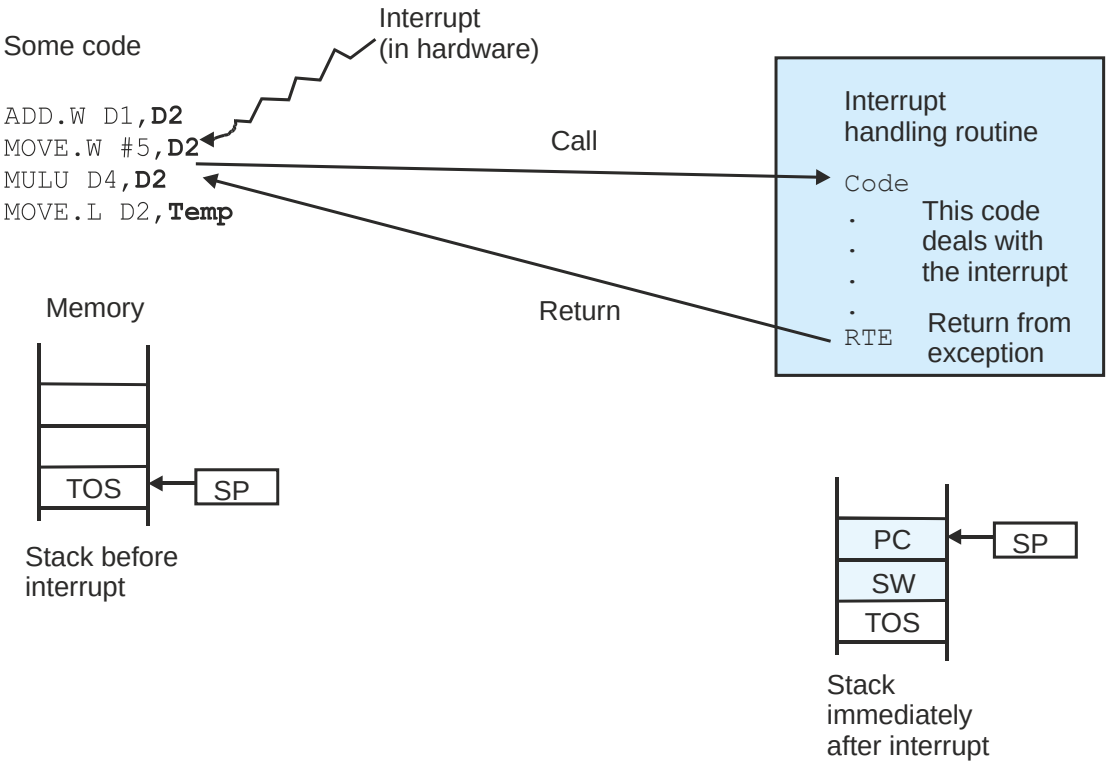
a)
An interrupt or exception is a message from a hardware device, from within the computer, or from a programmer initiated instruction that requests the computer to suspend normal processing and to deal with the cause of the exception. A hardware interrupt may come from an I/O device requesting attention (keyboard or mouse), the memory management system (a page-fault where the data being accessed is not in memory), or some other event (low-voltage,

thermal runaway etc). A software interrupt can be generated by an event such as an illegal op-code, an illegal arithmetic operation (dividing by zero), or an illegal address. Each of these exceptions requires the operating system to intervene and deal with the problem. Software interrupts (often called a system call or trap) are used by the programmer to request a function from the operating system such as disk I/O.

b)

An interrupt is dealt with by the processor's hardware. On detecting an interrupt, the processor may ignore it if the level of the interrupt is below that of any interrupt currently being handled or its level has been turned off (masked). If the interrupt is accepted, the current instruction is executed to completion (or the current machine status saved to allow instructions in the process of execution to be restarted). The address of the next instruction is saved (either on the stack in a CISC machine or in a register in a RISC machine). The machine status is also saved.
The appropriate interrupt or exception processing is then called (this routine called an exception handler and is part of the operating system). Finally, a return from interrupt is made and the execution continues from the instruction immediately after the last pre-interrupt instruction executed.

The following figure illustrates the concept of an interrupt (in this case it is hardware based).



c)

Interrupts/exceptions and subroutines are very similar. There are differences:
An interrupt can be masked or turned off by the operating system. A subroutine call is always executed.

A subroutine call saves the return address. An interrupt saves both the return address and the system status (carry and zero flags etc). This step is necessary because an interrupt must not affect the outcome of later conditional tests.

A subroutine has an explicit programmer-supplied target address (e.g. BSR ABCD where ABCD is the address of the subroutine). An interrupt/exception does not need an explicit address because the processor automatically vectors the exception to the appropriate handler.

d)
Without interrupts you would have to use polling. That is, when you wish to perform an I/O operation you would have to "ask" the source or destination of the data whether it was ready. Such a polling loop is inefficient because the processor has to wait until the I/O device is being tested becomes ready; for example:

```
Input  TestKeyboard
       Repeat until ready  //this is the polling loop
       Read data
```

However, polled systems are well-behaved in the sense that they happen under programmer control. Interrupts are asynchronous and can happen at any time. It is very difficult to precisely predict the behavior of a complex system with many sources of interrupt.

Examiners' comments

Most candidates who attempted this question were able to explain the meaning of the term interrupt. However, answers to part b) were unclear. Candidates did not show a good understanding of how interrupts can be used to manage input/output transactions. The last two parts of this question were poorly answered. Many candidates did not understand what a subroutine is.

A4

Answer Pointers

Some of the issues to consider in this question are:

Changes over the last six years ago:

A modern tablet has more computational power (some now have 1GHz multiple core processors with 1GB RAM and 64GB flash memory) than many desktops PCs had a few years ago. Moreover, a modern tablet has built in Wi-Fi (and hence Internet) connectivity. Moreover, the resolution of a modern tablet's display is greater than that of many older desktop processors.

The modern processor (CPU) is far more powerful than previous generations – however pure computational speed is no longer critical except in specialized applications (such as some multimedia processing and number crunching). PCs and desktops have the advantage that they offer greater peripheral connectivity than tablets (e.g. via printers and scanners or special interfaces).

A very important consideration is changes in both education and students. The number of students involved in higher education continues to grow. Consequently, there is pressure on education authorities to bring down the cost of education. Stressing the use of tablets moves costs from institutions to individual students – labs of desktop processors have to be maintained (and secured against theft). Moreover, patterns of work and study are often more variable today (part time study, distance learning). Consequently, students can study at home or work even when travelling – this makes the tablet particularly suited to individual study.

However, specialist software in not always readily available for tablet-based environments. This means that subjects using particular packages (engineering, medicine) are likely to remain

desktop-based for some time, whereas subjects like literature, languages, and history are well-suited to tablet environments.

Another factor in the choice between desktop and tablet in education is the behavior and expectation of the students themselves. Tablets are largely extensions of smartphones and many students today are intimately familiar with that technology and software.

Examiners' comments

Most candidates attempted this question well. They provided relevant comments and justifications of traditional computers and tablets. Arguments put forward were valid and clear. Good answers included a balanced view of how tablets and PCs are being used.

Section B

B5

Answer Pointers

a) The processor or central processing unit of the computer which enable it to carry out different functions/tasks; the processor is made by Intel and is part of a family of processors; iCore 5 processor is faster and provides a range of other benefits such as high quality graphics.

b) The speed at which the computer will handle tasks. It refers to the rate at which instructions can be processed.

c) The internal storage or memory of the computer; the amount of data/instructions which can be stored on the computers RAM.

d) The external storage of the computer; the storage space available on the computer's hard disk.

e) The screen or monitor of the computer; the output device where users can view information from the CPU.

f) USB port based on Plug and Play techniques to connect a range of devices; e.g. pen drive, printer, data projector, etc.

Examiners' comments

Most candidates attempted this question well. They provided relevant explanations of these key terms and components. Good answers included suitable examples of these.

B6

Answer Pointers

Both intranet and extranet are based on internet protocols.

An intranet is one which is internal to an organisation. It is based on a LAN. It is used to provide a range of services to staff and internal users of an organisation.

An extranet allows external users to access an organisation's resources. Suitable security processes are required to ensure only authorized people are allowed to access the network.

Examiners' comments

Most candidates attempted this question well. They showed a good understanding of intranet and extranet. Some candidates provided relevant examples of their organisations where these are used.

B7

Answer Pointers

Executable file – a file which is in a format which runs directly without the need for any additional software or facility; this file cannot be read and understood by a user.

Compressed file – this file is used to store data in a format which requires less storage space; this type of file is suitable for transfer data electronically.

Database file – file used to store data as part of a database; data is kept in a structured format; for example, relational database file as available in Microsoft Access.

Examiners' comments

Candidates provided reasonably good answers. They were able to explain the differences between these types of files. Weaker answers did not acknowledge the need to store data using database files.

B8

Answer Pointers

a) Page fault is an interrupt that occurs when a program requests data that is not currently in real memory. The interrupt triggers the operating system to fetch the data from a virtual memory and load it into RAM.

   An invalid page fault or page fault error occurs when the operating system cannot find the data in virtual memory. This usually happens when the virtual memory area, or the table that maps virtual addresses to real addresses, becomes corrupt.

b) Routing table is a table which is kept by a router which lists the routes to network destinations. The table is useful in determining the paths of data taken when it is transferred from point A to B in a network.

c) Hashing is a process used when accessing data or for data security. During data transmission, the sender generates a hash value which is encrypted and sent alongside the data. The recipient decrypts the message and the hash and also generate another hash. If the two hashes are the same, it means that the message was transmitted without tampering.

Examiners' comments

The majority of candidates who attempted this question answered it poorly. They had little knowledge of these operating system tasks in a computer system.

B9

Answer Pointers

a) Hard disk – storage device available to store a range of applications and data permanently in a computer system; It is a fundamental device for a computer to operate efficiently.
b) Pen drive – also known as a USB device; used to store software and files which can be carried around for ease of use. The pen drive uses the plug and play technique.
c) DVD – storage device which is used to store large amount of information (compared to pen drive which is limited In capacity). The DVD is suitable for storing games, movies and large software. There are different variations of the DVD including the rewritable one.
d) Magnetic tape – traditional storage device which is used to store data sequentially. The tape is used in larger computer systems for backing up information.

Examiners' comments

Most candidates attempted this question well. They provided relevant comments and justifications for using these different types of storage devices.. Arguments put forward were valid and clear. Good answers included comments on how each device can be used.

B10

Answer Pointers

Virus – probably the oldest and most dangerous threat. Viruses replicate via direct transportable media (once floppy disk and now flash media), or through the Internet. A virus can carry a payload that may cause an arbitrary amount of damage to the computer.

Trojan horse - A Trojan horse is an example of malware that hides in a legitimate program. Trojan horses are sometime found in programs that are distributed; for example, with freeware and shareware.

Worm - A worm is a message that is designed to replicate itself. It has some characteristics of a virus, but is usually intended to replicate to the extent that data channels become clogged by the endless repetition of worms. It is used as a means of service denial.

Pop-up - enters a computer system and runs on the system to cause varying degree of damage. For example, pop-ups carry marketing/advertising information and can slow down the operation of a computer.

Examiners' comments

Most candidates attempted this question well. They were able to differentiate between the different types of malware. Some answers did not clearly show how these can be dealt with.

B11

Answer Pointers

a) An identifier for 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.

b) To understand how VoIP, short for Voice over Internet Protocol, works, it is helpful to compare it to how conventional telephone calls operate. When you place a "regular" phone call using the traditional Public Switched Telephone Network (PSTN), also known as Plain Old Telephone Service (POTS) you use what is called circuit-switched telephony. This system works by setting up a dedicated channel (or circuit) between two points for the duration of the call. These telephony systems are based on copper wires carrying analog voice data over the dedicated circuits.

   This is in contrast to newer Internet telephony networks based on digital technologies. VoIP, in contrast to PSTN, uses what is called packet-switched telephony. Using this system, the voice information travels to its destination in countless individual network packets across the Internet.

Examiners' comments

Candidates were not clear about IP addressing. They were unable to explain how this fundamental network concept is used. Most candidates simply mentioned 'Skype' for VoIP.

B12

Answer Pointers

Hardware:

PC or laptop: to initiate the connection, send and receive data/information.
Network card; needed in the PC or laptop
Router or Modem: to connect to the internet

Software:

Operating System such as MS Windows: to handle the main device management functions
Browsers such as MS Windows Internet Explorer or Mozilla Firefox to connect to the internet
Search engines: to download web pages e.g. Google Chrome or Bing

Services:

Internet Service Provider (ISP) to allow connections between a user and the internet/world wide web.

Examiners' comments

Most candidates did not attempt this question well, They merely listed various items of hardware and software. Knowledge of how to connect a computer to the internet needs to be clear and up to date.