Expected responses and commentary to Paper 1 examination-style questions

Chapter 1

1 a) Convert the following binary number into denary (base 10):
0 0 1 1 1 1 0 1 [1]

61

b) Convert the following denary (base 10) number into binary:
70 [1]

0 1 0 0 0 1 1 0

c) How many bytes are there in the following memory sizes (give your answer as a power of 2)?

i 1 KB

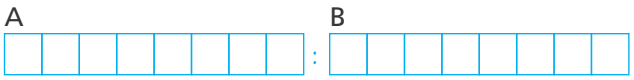
2^{10}

ii 1 GB [2]

2^{30}

d) An electronic timing device is microprocessor-controlled. The device uses the 24-hour clock.
Two 8-bit registers, A and B, are used to represent the number of hours and the number of minutes.

i Represent 19:54 using the two registers. [2]



Another 8-bit register, C, is used to represent the number of seconds.

ii Represent 29 seconds in register C. [1]

As soon as register C reaches the value 0 0 1 1 1 1 0 0, register B automatically increments by 1. As soon as register B reaches the value 0 0 1 1 1 1 0 0, register A automatically increments by 1.

The responses to parts a–c would be expected from a minimum grade D or E student. Grade C, B or A students would obviously be expected to give answers at least equivalent to this. A grade A or B student would probably expand on the answers in part c and give 1024 and 1 073 741 824, but these wouldn't be given any additional cr edit.

It is expected that students at C, B or A level would give the answers to part d.

iii What time is represented by the three registers below? [2]

A

0	0	0	1	0	1	1	0

B

0	0	1	1	1	0	1	1

C

0	0	1	1	1	0	1	1

A = 22

B = 59

C = 59

iv Show the contents of all three registers 1 second later. [2]

A

0	0	0	1	0	1	1	1

B

0	0	0	0	0	0	0	0

C

0	0	0	0	0	0	0	0

A grade C student may struggle to understand the concept in part iv and may only give answers to the first three parts. Students at D and E level would probably attempt parts i to iii but values other than 0 or 1 may be seen in the registers since the concept of other number bases is difficult at this level.

e) i Convert the hexadecimal number A F 1 to denary. [2]

2801

ii Convert the denary number 3080 to hexadecimal notation. [2]

C08

f) Give **three** reasons why the hexadecimal system is used in computers. [3]

Reference to HTML code, memory dumps and used in low-level languages.

Only A and B grade students would be expected to complete part e. A grade A student may distinguish themselves further by showing the systematic working out of part ii. In many cases, grade C students would make a reasonable attempt at part i but would struggle to supply an answer for part ii. Students at D and E level, would be unlikely to make a significant attempt at part e.

Since part f is essentially 'book work', students across the whole spectrum may gain some credit here with the number of correct hexadecimal applications diminishing with the capability of the student.

2 a) Describe what is meant by a MAC address. Include in your answer the meaning of the different components in a MAC address. [3]

Media Access Control (MAC) address refers to a number which uniquely identifies a device on the internet. The MAC address refers to the network interface card (NIC) which is part of the device.

A MAC address is usually made up of 48 bits which are shown as six groups of hexadecimal digits (although 64-bit addresses are also known):

NN – NN – NN – DD – DD – DD or NN:NN:NN:DD:DD:DD

where the first half (NN – NN – NN) is the identity number of the manufacturer of the device and the second half (DD – DD – DD) is the serial number of the device.

Sometimes lower case hexadecimal letters are used in the MAC address: 00-1c-b3-4f-25-fe.

b) What is the difference between UAA and LAA MAC addresses? Explain why both types are used. [4]

It should be pointed out that there are two types of MAC address: the Universally Administered MAC Address (UAA) and the Locally Administered MAC Address (LAA).

The UAA is by far the most common type of MAC address and this is the one set by the manufacturer at the factory. It is rare for a user to want to change this MAC address.

However, there are some occasions when a user or organisation wishes to change their MAC address. This is a relatively easy task to carry out but it will cause big problems if the changed address isn't unique.

A grade D or E student would probably attempt to give the parts of the definition as shown in part a. You are unlikely, however, to see anything more than the basic definition at grade E level. Students at a higher level would include other information, such as:

The MAC address is rarely changed so that a particular device can always be identified no matter where it is.

A grade B or A student may go one stage further and give an example of a MAC address such as:

00 – 1C – B3 – 4F – 25 – FE is the MAC address of a device produced by the Apple Corporation (code: 001CB3) with a serial number of 4F25FE.

A grade C student would probably give a fairly superficial response such as that shown for part b with an explanation of the two abbreviations and some idea of why both types are needed. Students at D and E level may give some attempt at explaining the two abbreviations. While it is expected that students at a higher level (A and B) would give at least the information shown here, it is very likely they would go one stage further and include reasons for LAA.

There are a few reasons why the MAC address needs to be changed using LAA:

- Certain software used on mainframe systems needs all the MAC addresses of devices to fall into a strict format; because of this, it may be necessary to change the MAC address of some devices to ensure they follow the correct format.
- It may be necessary to bypass a MAC address filter on a router or a firewall; only MAC addresses with a certain format are allowed through and devices will be blocked if their MAC address doesn't adhere to the correct format.
- To get past certain types of network restrictions it may be necessary to emulate unrestricted MAC addresses; hence the MAC address may need to be changed on certain devices connected to the network.

c) What is meant by an ASCII code?
Using the ASCII code table in the textbook, show how:
www.teacher_cd.co.uk/html
would be represented in ASCII using hexadecimal codes from the table. [4]

Each character used on a keyboard has what is known as an ASCII code (American Standard Code for Information Interchange). These codes can be represented using hexadecimal values or decimal values. The % sign is used to denote that hexadecimal is being used in the code.

w w w . t e a c h e r _ c d . c o . u k / h t m l in hexadecimal is:
%77%77%77%2E%74%65%61%63%68%65%72%5F%63%64
%2E%63%6F%2E%75%6B%2F%68%74%6D%6C

A grade B or A student would be expected to apply the concept of ASCII codes to a web address as shown in part c. A grade C student would be aware of the concept of ASCII codes, but may be unable to apply their knowledge to an example. But some grade C students may make a good attempt and convert the 'uncomplicated parts' (the lower case letters) to ASCII. A grade D or E student would find this difficult due to the use of hexadecimal notation.

Chapter 2

3 a) What is meant by the terms:

i simplex data transmission

Simplex: data transmission in one direction only (i.e. from sender to receiver). Example: data being sent from a computer to a printer.

ii full-duplex data transmission? [2]

Full-duplex: data transmission in both directions simultaneously (i.e. data can be sent from 'A' to 'B' and from 'B' to 'A' along the same line, both at the same time). Example: broadband connection on a phone line.

b) Describe the difference between synchronous and asynchronous data transmission. [3]

Asynchronous data transmission refers to data being transmitted in an agreed bit pattern. Data bits (1s and 0s) are grouped together and sent with control bits.

This means that the receiver of the data knows when the data starts and when it stops. This prevents data becoming mixed up; without these control bits, it would be impossible to separate groups of data as they arrived.

Synchronous data transmission is a continuous stream of data (unlike asynchronous data which is sent in discrete groups). The data is accompanied by timing signals generated by an internal clock. This ensures that the sender and receiver are synchronised with each other. The receiver counts how many bits (1s and 0s) were sent and then reassembles them into bytes of data. The timing must be very accurate here since there are no control bits sent in this type of data transmission.

c) Explain the difference between an IP address and a MAC address. [3]

Media Access Control (MAC) address refers to a number which uniquely identifies a device on the internet. The MAC address refers to the network interface card (NIC) which is part of the device.

A MAC address is usually made up of 48 bits which are shown as six groups of hexadecimal digits (although 64-bit addresses are also known):

NN – NN – NN – DD – DD – DD or NN:NN:NN:DD:DD:DD

where the first half (NN – NN – NN) is the identity number of the manufacturer of the device and the second half (DD – DD – DD) is the serial number of the device.

Sometimes lower case hexadecimal letters are used in the MAC address: 00-1c-b3-4f-25-fe

Each device on the internet is given a unique address known as the internet protocol (IP) address. This is a 32-bit number which is usually written in the form: 109.108.158.1

A home computer is given an IP address when it connects to the internet. This is assigned by the ISP and is unique for that particular internet session. The only IP addresses that remain fairly unchanged are the web servers.

Media access control (MAC) address is a unique number that identifies a device connected to the internet. The IP address gives the location of a device on the internet; whereas the MAC address identifies the device connected to the internet.

A grade D or E student will be able to give the 'book' definitions in part a. Students of higher ability will be able to give examples of where each method is used. It is common to see grade E students missing out the important words 'both at the same time' from the full-duplex definition.

Grade C students should be able to give most of the points in their answer to part b. Grade D and E students will probably be aware of a difference but will have difficulty explaining it. Good students (A and B grade) will probably also give examples to explain the differences, such as:

control bit control bit

start bit	1	0	1	1	1	1	0	0	1	1	1	0	1	0	1	0	stop bit

or they may compare the relative speeds of the systems:

Synchronous is a faster data transfer method than asynchronous and is therefore used where this is an important issue (for example, in network communications).

Students at level C would be expected to give the first half of the answer to part c (up to the example of an IP address). Lower ability students will give some of this answer but will be unlikely to give any of the examples shown and will simply stick to 'book' definitions.

The rest of the answer which attempts to differentiate between MAC and IP addresses will only be given with any real meaning by grade A and B students.

You can think of the IP address as the address of the house you live in (it will have some unique way of identifying it, such as a post or zip code). Using this example, the MAC address can be thought of as a way of uniquely identifying each person living in that house. It is possible to move house (so your IP address will change) but the same people will be living in the new house (so their MAC address will remain unchanged).

4 a) The first byte has even parity and the second byte has odd parity. Supply the missing parity bit in each case.

i [1]

	0	1	1	1	1	0	1

1

ii [2]

	1	1	0	1	1	0	0

1

All students at every level should get these answers for part a.

b) Describe **two** other methods which can be used to check for errors following data transmission. [4]

Description of ARQ:

- Automatic repeat request (ARQ) is another method used to check whether data has been correctly transmitted.
- It uses an acknowledgement (a message sent by the receiver indicating that data has been received correctly) and timeout (this is the time allowed to elapse before an acknowledgement is received).
- If an acknowledgement isn't sent back to the sender before timeout occurs, then the message is automatically resent.

Description of checksum:

- Checksum is another way to check if data has been changed or corrupted following data transmission. Data is sent in blocks and an additional value, the checksum, is also sent at the end of the block of data.

Students at A, B or C level would be expected to give most of the description for part b. Grade A students may embellish their answers with examples to show how errors are detected. At D or E level, you might expect to see some mention of signal acknowledgement and the idea that the bytes are summed before transmission; the rest of the description would be unclear or incorrect.

c) A system uses even parity. Seven bytes were transmitted together with a parity byte. The bytes arrive at their destination as shown in Table 2.1.
One of the bits has been altered during the transmission stage. Find the erroneous bit and identify which byte has been corrupted. Explain how you arrived at your answer. Write down the correct value of the byte before corruption. [4]

Table 2.1

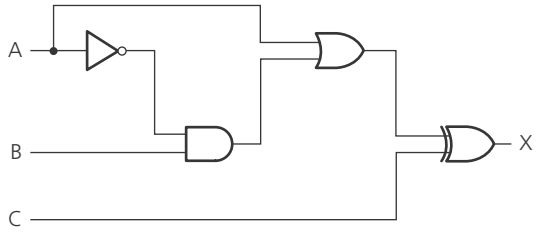
	parity bit	bit 2	bit 3	bit 4	bit 5	bit 6	bit 7	bit 8
byte 1	0	1	0	1	0	0	0	0
byte 2	1	1	0	1	1	0	1	1
byte 3	1	0	1	1	1	0	1	0
byte 4	1	0	1	0	0	0	1	1
byte 5	0	1	1	1	0	1	0	0
byte 6	0	0	0	0	1	0	1	0
byte 7	1	1	1	0	0	0	0	1
parity byte	0	0	0	0	1	1	1	1

The error is in row 3, column 7. Where the row and column intersect indicates which bit is in error.
The corrected byte should be: 1 0 1 1 1 0 0 0.

A grade A student would be expected to get all four parts of the answer to part c correct. Students at C level, would be able to point out where the erroneous bit existed, but may have difficulty explaining their reason fully. Grade D/E students would probably pick out where the parity was wrong but would be unable to identify which bit was corrupted.

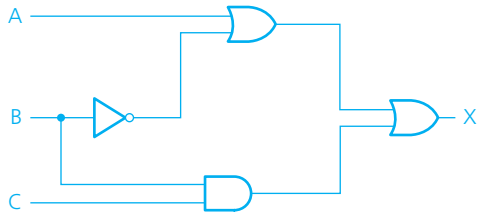
Chapter 3

5 a) Complete a truth table for the following logic circuit: [4]



Input			Output
A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

b) Produce a logic circuit to represent the following logic statement:
X = 1 if (A = 1 OR B = NOT 1) OR (C = 1 AND B = 1)
X = (A + B) + (C . B) [4]



Students at all levels should get the full marks for part a. Occasionally grade E students get confused and add up the 1-values giving values in the X column of: 0, 1, 1, 2, 1, 2, 2, 3.

Students at grade C to A level should get most of the logic circuit right. The most likely error at grade C would be the top input to the AND gate; this input may come from AFTER the NOT gate instead of being tapped off before the NOT gate. Grade D or E students often struggle to draw these logic circuits and it will be common to see one-input AND/OR gates and logic circuits that bear little resemblance to the one in part b.

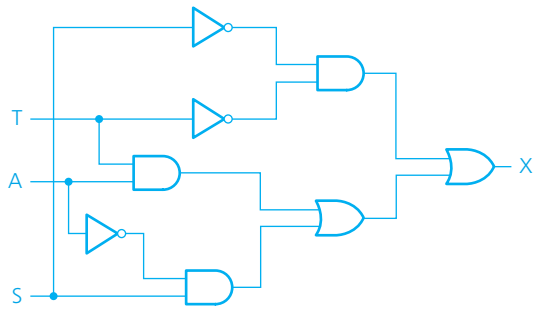
c) A chemical experiment is being monitored by three devices which send binary values 0 or 1 to a logic circuit. The conditions being monitored and binary values produced are shown in Table 3.1.

Table 3.1

Parameter	Description	Binary value	Conditions
T	temperature	0	temperature < 95 °C
		1	temperature >= 95 °C
A	pH (acidity)	0	pH > 10
		1	pH <= 10
S	stirrer speed	0	rotation > 800 rpm
		1	rotation <= 800 rpm

An error, X, is output from the logic circuit if:
either: temperature >= 95 °C AND pH <= 10
or: pH > 10 AND stirrer speed <= 800 rpm
or: temperature < 95 °C AND stirrer speed > 800 rpm
Produce a logic circuit and truth table to represent the above system. [10]

Logic circuit:
X = 1 if (T = 1 AND A = 1) OR
(A = NOT 1 AND S = 1) OR
(T = NOT 1 AND S = NOT 1)



Input			Output
T	A	S	X
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Grade A and B students will get all or most of the logic circuit in part c correct. The best grade A students may even attempt to simplify the circuit by reducing the number of gates. Grade C students may get the logic statement and make a reasonable attempt at producing a logic circuit. Grade D or E students are very unlikely to produce a meaningful logic circuit but may get some of it right by applying simple logic. The full range of marks is expected since there are many ways to tackle this type of problem.

Because the truth table can be obtained directly from the original problem statement, grade A to C students are very likely to get the truth table completely correct. Grade D and E students may get some of it right if they understand the problem in logic terms. Again, expect the full range of marks (0 to 4) since there are two or three ways of tackling this problem.

Chapter 4

6 a) Give **three** features of a typical operating system. [3]

Any three from:

- multitasking
- multiprogramming
- interface
- batch processing
- error handling
- loading/running applications
- manage user accounts
- file utilities
- processor management
- memory management
- real time processing
- interrupt handling
- security
- input/output control.

b) Explain the two terms:

i buffer

Buffers are used in computers as a temporary memory area. These are essential in modern computers since hardware devices operate at much slower speeds than the processor. If it wasn't for buffers, processors would spend the majority of their time idle, waiting for the hardware device to complete its operation. Buffers are essentially filled from the processor or memory unit and are emptied to the hardware device while the processor carries on with other tasks. Buffers are used, for example, when streaming a video from the internet. This ensures that the video playback doesn't keep on stopping while waiting for data from the internet.

ii interrupt. [2]

An interrupt is a signal sent from a device or from software to the processor. This will cause the processor to temporarily stop what it is doing and service the interrupt. Interrupts can be caused by, for example:

- a disk drive becoming ready to receive more data
- an error occurring, such as a paper jam in a printer
- the user pressing a key to interrupt the current process – an example could be <CTRL><ALT><BREAK> keys pressed simultaneously
- a software error occurring – an example of this would be if an .exe file couldn't be found to initiate the execution of an program.

c) Describe how buffers and interrupts are used when a document is sent to be printed. [4]

The necessary stages are:

- data from the document to be printed is sent to the (printer) buffer from the computer memory
- the contents of the (printer) buffer are emptied to the printer and the data from the document is printed
- meanwhile, the processor is able to carry out other tasks while the (printer) buffer is being emptied
- when all the data has been printed, the (printer) buffer becomes empty; an interrupt signal is then sent to the processor
- this interrupt signal is sent to request more data to be sent to the printer
- the current task is suspended whilst the interrupt is serviced.

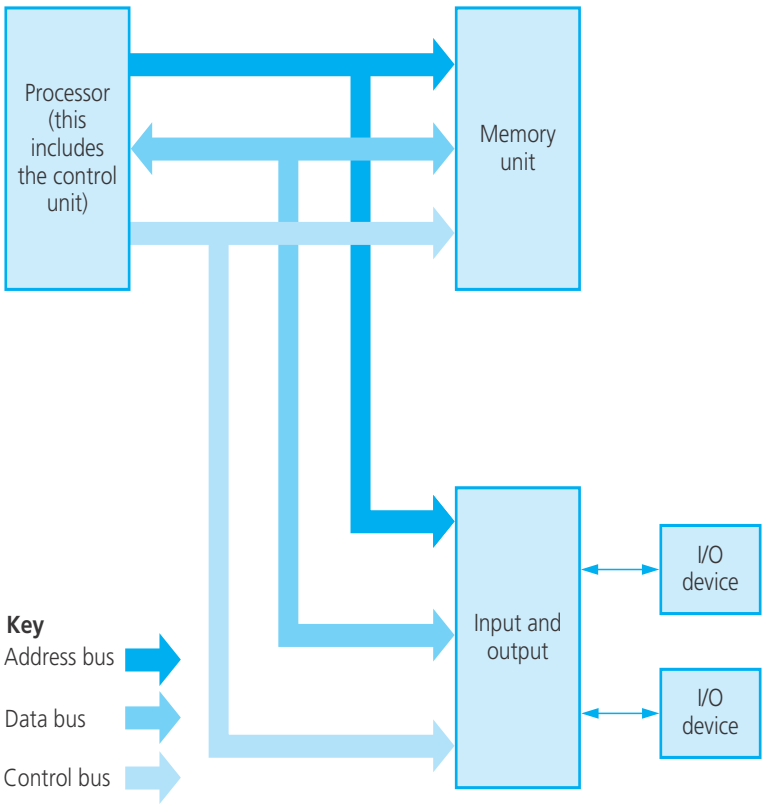
Grade A to C students are likely to get three of these examples in part a. At grade D or E level, some of the features will be confused, e.g. resource management (too vague) or managing processes (confused with processor management). Grade D candidates will probably get some of them right and, if they have learnt their book work, may even get the full marks.

Grade C students will usually say just enough to gain the two marks, i.e. a buffer is a temporary memory area and an interrupt is a signal sent from a device to the processor. This will be enough to secure the marks. Grade A and B students are likely to go on and give an example of each even though it probably isn't necessary unless the question asks for this. In which case, this would become a grade A to C question. Grade D/E students may have learnt the definitions but are likely to get them confused and write: a buffer is a memory (forgetting the important word 'temporary') or that an interrupt is a message/data sent TO/FROM the computer (too vague and potentially incorrect). Pure rote learning can ensure the two marks at any level.

Only grade A students are likely to get the 4 marks for part c (potentially 6 marks are available – one for each step); grade B students will tend to get the first three points and then start to go wrong. At grade C level, some of the steps will be correctly given (e.g. data is sent to the printer buffer or the processor can carry on with other tasks) but the concept will be too difficult for them to grasp what is actually going on. Grade D and E students will attempt to gain marks by trying to define buffer and interrupt and may stumble on one of the six steps in their definition.

7 a) Describe the structure of the von Neumann model. [3]

Possible answer:



b) The part contents of the memory of a computer are shown in Table 4.1.

Table 4.1

Address	Contents
10000000	11110000
10000001	01110011
10000010	11110011
10000011	00001110
10000100	00111100
10111110	
10111111	
11000000	

i The WRITE operation is carried out on location: 10000010.
What are the contents of MAR and MDR?

MAR

1	0	0	0	0	0	1	0

MDR

1	1	1	1	0	0	1	1

It is very unlikely that a grade D/E student will get the diagram correct in part a but they can get their marks by naming the parts: processor, memory unit, buses, address bus, control bus, data bus, i/o devices. Grade C students are more likely to name the buses or make some attempt at showing how the components link up. At grade A/B level, reasonable attempts at a diagram similar to that here are very possible; but many will gain marks by naming all the components and mention buses and registers.

ii Value 0 1 1 0 0 1 1 1 is to be written into location 1 0 1 1 1 1 1 1.
What are the contents of MDR and MAR? Also show the updated memory contents. [5]

MDR

0	1	1	0	0	1	1	1

MAR

1	0	1	1	1	1	1	1

0 1 1 0 0 1 1 1 is written into location 1 0 1 1 1 1 1 in the memory map.

c) Put the following fetch–execute cycle stages into their correct sequence.

1 address is then copied from PC to MAR using the address bus
2 contents of MDR are copied and placed into the CIR
3 contents of memory location in MAR are copied temporarily into MDR
4 instruction is finally decoded and executed by sending signals to components in the computer system
5 PC contains the address of the memory location of next instruction to be fetched
6 value in PC is incremented by 1 so it now points to the next instruction to be fetched [6]

The correct sequence is: 5 1 3 2 6 4

Grade A to C students will get most of part b right. The most likely error at B and C level is to confuse registers MAR and MDR. Grade D/E students will be very confused by the concept of memory locations and addresses; they are more likely to get part i right since this just involves looking at the address and seeing what value is stored there.

Grade A and B students are likely to get most of part c right but may confuse one or two of the steps. Grade C students are likely to get the first step and last step correct. Grade D/E students will make an attempt and may get some of them right by the law of averages but they won't understand the concept of the fetch–execute cycle.

Chapter 5

8 a) Name **two** input and **two** output devices used at a point-of-sale terminal (checkout) at a supermarket. Give a reason for your choice in each case. [4]

- Keyboard/keypad: to input number of items bought/barcode if it can't be read by the barcode reader.
- Scanner: to read the barcode on the item.
- Monitor/touchscreen: to show prices/to select items (e.g. fresh food).
- Speaker/beeper: to make a noise if error occurs/confirm barcode read correctly.
- Magnetic stripe reader: to read the magnetic stripe on credit/debit card.
- Electronic scales: to weigh loose items at checkout.
- Printer: to output itemised bill of sale.

b) Describe the operation of a barcode reader.
What are the advantages to customers of supermarkets using barcode technology? [6]

The barcode is first of all read by a red laser or red LED (light emitting diode).
Light is reflected back off the barcode; the dark areas reflect little or no light which allows the bars to be read.
The reflected light is read by sensors (photoelectric cells).
As the laser or LED light is scanned across the barcode, a pattern is generated which is converted into digital data – this allows the computer to understand the barcode.
Advantages to customers:

- faster checkout queues (staff don't need to remember/look up prices of items)
- errors in charging customers are reduced
- the customer is given an itemised bill
- cost savings can be passed on to the customer
- better tracking of sell-by dates so food should be fresher.

c) Barcodes are made up of alternate dark and light lines. Describe how the computer can interpret these lines. [4]

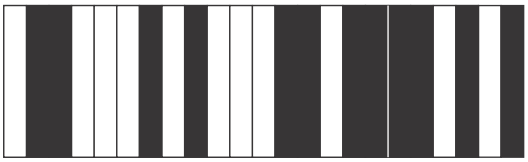


Figure 5.1 A barcode

L D D L L L D L D L L L D D L D D D D L D L D
This is interpreted as: 0 1 1 0 0 0 1 0 1 0 0 0 1 1 0 1 1 1 1 0 1 0 1

Grade D/E students will get the obvious answers to part a like barcode scanner and keypad. It is unlikely they will get all the reasons. When marking this question, it is probably best to 'mentally' award $\frac{1}{2}$ mark for device and $\frac{1}{2}$ mark for reason and then round up at the end. Grade C students are likely to get the devices but struggle in some cases to give a valid reason for choice. Grade A/B students should find this to be a fairly easy question and should get four devices with good reasons.

Grade A to C students will get most of these answers to part b right. A grade C student is most likely to do well on the customer advantages and less well on the description of how barcode readers work. When marking the question it is best to award a maximum of 3 for each of the two parts. Students at D/E level are likely to get 1 or 2 of the customer advantages and very few will get any marks for how barcode readers work.

Grade A/B students should be able to explain the connection between dark/light lines and their binary values in part c. They will give examples to show what they mean. Better students will also include a diagram (as in Figure 5.1) to help explain their answer. Students at grade C level will probably explain that dark = 1 and light = 0 but are unlikely to give any examples to explain their answers. At D/E level, some idea that either thickness of line or colour of line equates to a (binary) value is possible but it is unlikely that an example will be given to explain how it works.

d) Explain how barcodes are used in automatic stock control systems. [4]

The barcode number is looked up in the stock database (the barcode is known as the key field in the stock item record); this key field uniquely identifies each stock item.
When the barcode number is found, the stock item record is looked up.
The price and other stock item details are sent back to the checkout (or point-of-sale terminal (POS)).
The number of stock items in the record is reduced by 1 each time the barcode is read.
This new value for number of stock is written back to the stock item record.
The number of stock items is compared to the re-order level; if it is less than or equal to this value, more stock items are automatically ordered.
Each time a stock item is sold, the number in stock is compared to the re-order level.
Once an order for more stock items is generated, a flag is added to the record to stop re-ordering every time the stock item barcode is read.
When new stock items arrive, the stock levels are updated in the database.

There are 9 marking points in part d so all candidates will have the opportunity of showing their knowledge. All candidates have the opportunity here to gain 4 marks depending on how well they have studied the automatic stock control system. Since it is almost pure book work, it is difficult to predict that grade A/B students will get full marks and this will diminish down the ability range. Grade D candidates can potentially do well if they have learnt this rote fashion. But it is regarded as a grade A/B question since it involves database management, setting of flags and so on.

9 a) What are QR codes? [2]

A Quick Response (QR) Code is a type of barcode. This is made up of a matrix of filled-in dark squares on a light background.

To make a comparison, normal barcodes can hold up to 30 digits; QR codes can hold over 7000 digits. This obviously gives greater scope for the storage of information.

Because of modern smartphones, which allow internet access on the move, QR codes can be scanned anywhere. This allows advertising of products on trains, buses, shopping malls and many other places. Using the built-in camera facility on modern phones, and by downloading the appropriate application (or app), it is possible to read the QR code. The code may contain a website link or some form of advertising. For example, a QR code may contain a telephone number and an advertisement for free pizzas if ordered today. On scanning the QR code, the phone number and advertisement will appear on the mobile phone's screen.

A grade D/E student will get some of the points in the description in part a. They will have some idea of how they work (probably from their own experiences with smartphones). Better candidates will go on to give examples as shown – it is up to the person using this type of question whether or not they award additional marks for examples; if so, this takes the question to the next level (grade C).

b) Describe how 2D/3D scanners are used as part of the security system at an airport. [4]

2D scanners are used at airports to read passports. They make use of OCR technology to produce digital images which represent the passport pages. Because of the OCR technology, these digital images can be manipulated in a number of ways.

For example, the OCR software is able to review these images, select the text part, and then automatically put the text into the correct fields of an existing database. It is possible for the text to be stored in an ASCII format – it all depends on how the data is to be used.

At many airports the 2D photograph in the passport is also scanned and stored as a jpeg image. The passenger's face is also photographed using a digital camera (a 2D image is taken so it can be matched to the image taken from the passport). The two digital images are compared use face recognition/detection software. Key parts of the face are compared.

Grade A to C students will have a fundamental understanding of the technology described in part b. What will separate grade A/B students from grade C students is the description of face recognition software. This part of the system is likely to be omitted by the less able students. Grade D/E students will probably discuss OCR since they will see the word scanner; it is unlikely they will link it to the scenario and therefore miss the point about airport security.

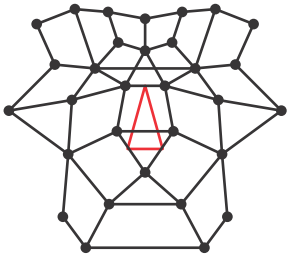


Figure 5.2 Showing points of comparison on a face

c) Describe the differences between *voice recognition* and *speech recognition* systems. [4]

If a microphone is being used in a voice recognition system, the user's voice is detected and then converted into digital data. A few words spoken produce a digital wave pattern. Software compares this wave pattern to wave patterns stored in memory to see if they match. If they match, then the person has been correctly identified. Only certain words can be used since the system is designed to recognise only a few key phrases (e.g. a user may be asked to say their name). This technology can be used in security systems.

Speech recognition is a different and more complex technology. This again uses a microphone to input words spoken by a user. But this time the software doesn't try to recognise the person talking. The spoken words are recognised and shown on a screen, input into a word processor or used in another application.

Only grade A/B students will be able to describe the subtle difference between the two processes in part c. It is also very likely for grade A students to give examples where each of the technologies are used. Grade C students are probably only able to explain what each method involves, but will be unable to explain why they are fundamentally different. It is unlikely for any examples to be given at this level. Expect a grade D/E student to explain what is meant by either of them (you are unlikely to get two definitions) but examples of either use won't be offered.

10 a) Name suitable sensors for:

i monitoring the environment in a greenhouse

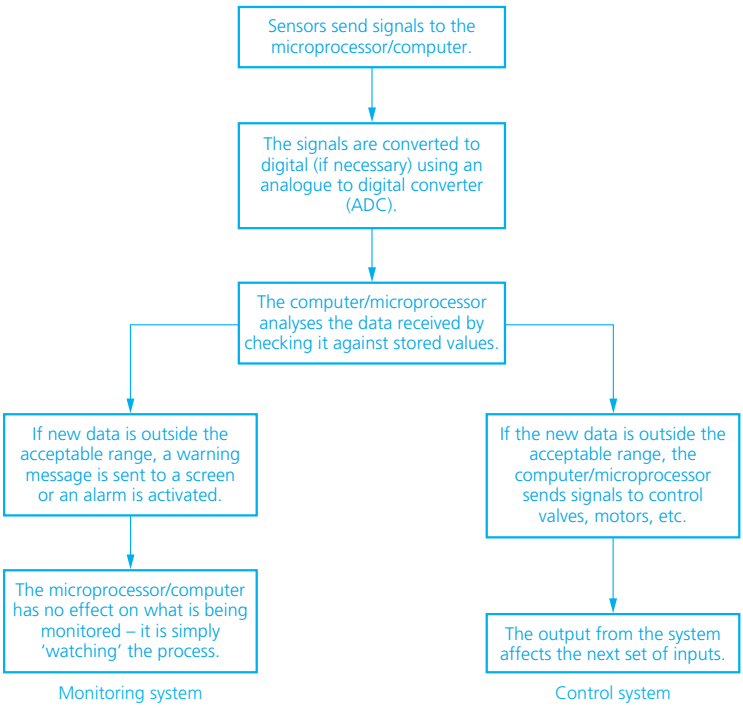
Temperature, oxygen/carbon dioxide, pH/acidity, moisture, humidity, light.

ii monitoring for intruders in a burglar alarm system. [3]

Infra-red/motion, temperature, pressure, acoustic/sound.

b) Explain the main differences between *monitoring* and *control* with reference to sensors and microprocessors. [3]

The following flowchart shows the main differences.



c) Describe how sensors and a microprocessor are used to monitor for intruders in a burglar alarm system. Consider all the inputs and outputs in the system. [6]

The burglar alarm monitoring system will carry out the following actions:

- the system is activated by keying in a password on a keypad
- the infra-red sensor will pick up the movement of an intruder in the building
- the acoustic sensor will pick up sounds such as footsteps or breaking glass
- the pressure sensor will pick up the weight of an intruder coming through a door or through a window
- the sensor data is passed through an ADC (if it is in an analogue form) to produce digital data
- the computer/microprocessor will sample the digital data coming from these sensors at a given frequency (e.g. every 5 seconds)
- the data is compared with the stored values by the computer/microprocessor
- if any of the incoming data values are outside the acceptable range, then the computer sends a signal to …
- a siren to sound the alarm, or to a light to start flashing
- a DAC is used if the devices need analogue values to operate them
- the alarm continues to sound/lights continue to flash until the system is re-set with a password.

Students at A to C level should get all these sensors in part a and get the maximum mark of 3. Grade D/E students will get most of them but with errors; heat sensors, water sensors or weight sensors are very likely to be seen – none of these exist in reality.

You are unlikely to get a flowchart explaining the differences, but this shows clearly the points that should be made by the students in part b. At grade C level, it is most likely that a system will be described (or possibly both), but is only at the higher level (A/B) that the differences between the two systems will be fully explained. However, by explaining what is meant by both monitoring and control, it is possible to gain the full marks without explaining why they are different. Grade D/E students will probably pick up 1 or 2 marks for mentioning that sensors gather data and it is sent to a computer via an ADC. You are unlikely to see much beyond that.

Most good students will gain 5 or 6 marks in part c since there are 14 parts in the process. Many will give 8 or 9 valid points if they fully understand how this monitoring system works. Grade C students will gain marks for sensors gathering data, reference to ADC and a comparison being made; some may gain an additional mark for mention of a siren or light being activated. Students in the A to C range will be expected to gain 3 to 6 marks here. Lower-ability students will get marks for naming items such as motion or infra-red sensors and the need for an ADC. However, at this level, a large number of students will believe that it is the sensors that do all the monitoring, make the decisions and send signals to lights/sirens. This is a fundamental error seen with candidates at D/E (sometimes at C) levels.

11 a) Give **two** applications of 3D printers. [2]

- The covering of prosthetic limbs can be made to exactly fit the limb.
- Making items to allow precision reconstructive surgery (e.g. facial reconstruction following an accident); the parts made by this technique are more precise in their design since they can be made from exact scanning of the skull.
- In aerospace, manufacturers are looking at making wings and other parts using 3D technology; the bonus will be lightweight precision parts.
- Fashion and art – 3D printing allows new creative ideas to be developed.
- Making parts for items no longer in production, e.g. suspension parts for a vintage car.

Most candidates at all levels should get at least two of these applications.

b) Describe the differences between 3D printers and inkjet printers. [3]

3D printers use additive manufacturing (i.e. the object is built up layer by layer); this is in sharp contrast to the more traditional method of subtractive manufacturing (i.e. removal of material to make the object). For example, making a statue using a 3D printer would involve building it up layer by layer using powdered stone until the final object was formed. The subtractive method would involve carving the statue out of solid stone (i.e. removing the stone not required) until the final item was produced. Similarly, CNC machining removes metal to form an object; 3D printing would produce the same item by building up the object from layers of powdered metal.

Direct 3D printing uses inkjet technology; a print head can move left to right as in a normal printer. However, the print head can also move up and down to build up the layers of an object.

Binder 3D printing is similar to direct 3D printing. However, this method uses two passes for each of the layers; the first pass sprays dry powder and then on the second pass a binder (a type of glue) is sprayed to form a solid layer.

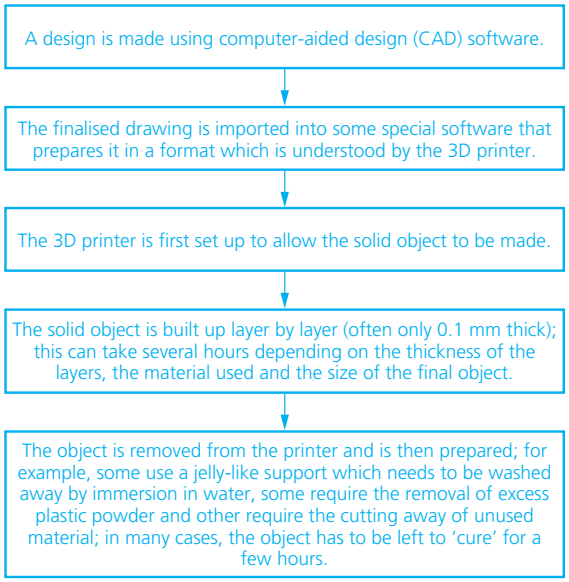
Inkjet printers spray ink onto paper in two dimensions. They use ink and paper as their output media.

No solid item is built up with the standard inkjet printer.

Grade A to C students will probably get some of the differences given in part b. Better students will attempt to differentiate the two. At grade C level, a description of both types of printer is likely, with no real comparison being made. At D/E level, answers are most likely just to explain how the inkjet printer works with little or no reference to the functionality of the 3D printer.

c) Describe how a blueprint design is made into a solid object using a 3D printer. [4]

There are a number of steps in the process of producing an object using these 3D printers. The steps are summarised below:



A grade A/B student is likely to get 3 or 4 points from the diagram shown in part c. At grade C level, expect to see two of the points (design stage and printing stage). It is unlikely to see many marks at D/E level, since the operation of 3D printers is probably a little too complex and it is also unlikely that they will have seen one in operation.

Chapter 6

12 a) i A music file is 40 MB in size. The file is being stored in MP3 format which reduces the file size by 90%. What will be the size of the music file in MP3 format? [1]

4 MB

ii How many MP3 files (assuming they are all the same size as calculated in part i) could be stored on a CD with a capacity of 800 MB? [2]

200 files

All students should have little difficulty in answering part a correctly. To make it more difficult, fractional file sizes could be used (e.g. 3.2 MB) and/or the memory size of the storage media could be given as 4 GB requiring some knowledge of memory measurement.

If we now asked how many files could be stored, then 4 GB = 4 x 1024 MB. So the number of files would be: (4 x 1024)/3.2 giving the answer: 1280 files.

Some manufacturers use powers of 10 for storage, in which case the calculation would become (4 x 1000)/3.2 giving 1250 files. As long as the students indicate clearly which convention they are using, this won't cause a problem.

b) i MP3 is an example of lossy file compression. Explain the terms:

lossy file compression

Lossy file compression is very different to lossless file compression. With this technique, the file compression algorithm eliminates unnecessary bits of data.

It is impossible to get the original file back once it is compressed. This is why it is chosen for files where removing certain bits of data doesn't detract from the overall quality.

lossless file compression.

With lossless file compression, all the data bits from the original file are reconstructed when the file is again uncompressed. This is particularly important for files where loss of any data would be disastrous – for example, spreadsheet files need to be stored in lossless format.

ii Explain why a jpeg file will lose its sharpness if enlarged too much. [4]

The number of pixels per square centimetre becomes smaller as the image is enlarged. This means the pixel density goes down. The consequence of this is to reduce the sharpness of the image.

In part b, a grade A to C student should know most of the answer for part i. The second part may cause problems to a grade C student, although they should be able to identify that the number of pixels per square centimetre reduces as the image is enlarged. Students at D/E level may get some of the answer to part i (e.g. lossy files can't be restored back to the original file), but it is very unlikely that they will be able to answer part ii.

c) Explain why MP3 files retain music quality even though their file size is only 10% of the original file size. [3]

Music quality is retained by using file compression algorithms which use perceptual music shaping; this essentially removes sounds that the human ear can't hear properly. For example:

- removal of sounds outside the human ear range
- if two sounds are played at the same time, only the louder one can be heard by the ear, so the softer sound is eliminated.

This means that certain parts of the music can be removed without affecting the quality too much.

Normally, only grade A/B students can come to grips with how MP3 file formats don't sacrifice music quality. Grade D/E students will draw a blank here and it unlikely that they will give any of the answers in part c. Students at the mid-range level may get one or two of the bulleted points, but it is unlikely to see a student at this level gain more than half marks.

13 a) Explain the differences between RAM and ROM memories. Give a use for each type of memory in a computer system. [4]

The features of Random Access Memory (RAM) are:

- they are volatile/temporary memories (the contents of the memory are lost when the power to the RAM is turned off)
- they are used to store: data, files, or parts of the operating system that are currently in use
- they can be written to or read from and the contents of the memory can be changed.

The main features of Read Only memory (ROM) can be summarised as:

- they are non-volatile/permanent memories (the contents of the memory remain even when the power to the ROM is turned off)
- they are often used to store the start-up instructions when the computer is first switched on (for example, ROM might store the basic input/output system (BIOS))
- the data or contents of a ROM chip can only be read; they cannot be changed.

b) Describe the advantages of using solid state memories rather than hard disk drives. [4]

The main benefits of SSDs are summarised below:

- they are more reliable (no moving parts to go wrong)
- they are considerably lighter (which makes them suitable for laptops)
- they don't have to 'get up to speed' before they work properly
- they have a lower power consumption
- they run much cooler than HDDs (both these points again make them very suitable for laptop computers)
- because of no moving parts, they are very thin
- data access is considerably faster than HDD.

c) Compare the technology that underpins DVDs, Blu-ray™ disks and DVD-RAM. [6]

DVD technology is slightly different to that used in CDs. One of the main differences is the use of dual-layering which considerably increases the storage capacity. Basically, this means that there are two individual recording layers. Two layers of a standard DVD are joined together with a transparent (polycarbonate) spacer, and a very thin reflector is also sandwiched between the two layers. Reading and writing of the second layer is done by a red laser focusing at a fraction of a millimetre difference compared to the first layer.

The main differences between DVD and Blu-ray disks are:

- a blue laser, rather than a red laser, is used to carry out read and write operations; the wavelength of blue light is only 405 nanometres (compared to 650 nm for red light)
- using blue laser light means that the 'pits' and 'bumps' can be much smaller; consequently, Blu-ray can store up to five times more data than normal DVD
- Blu-ray uses a single 1.1 mm thick polycarbonate disk; normal DVDs use a sandwich of two 0.6 mm thick disks
- using two sandwiched layers can cause birefringence (light is refracted into two separate beams causing reading errors); because Blu-ray uses only one layer the disks don't suffer from birefringence

(answer continued overleaf)

It is expected that a grade D student will give correct definitions of RAM and ROM in their answer to part a and struggle a little to give uses of both types of memory. Grade E students are likely to get the two confused but will probably gain half the marks. Grade C students will perform slightly better, but very few will gain full marks. Grade A/B students should find questions of this type quite straightforward.

There are 4 marks allocated for part b; mid-range students will get 2 to 3 marks since the idea of light weight, no moving parts and lower power consumption will be well known to them. Grade D/E students may get one or two of the answers because of their exposure to modern laptop computers. Top-end students should manage to gain full marks since this is essentially book work.

Only grade A students will give many of the features described in the answer to part c. The top students may even be able to quote variations in laser wavelength used by the three technologies. At the next level, still expect to see some good answers, but examples to explain the differences are unlikely. Mid-range (C) students will probably gain 3 to 4 marks for giving general descriptions (DVD uses red lasers, Blu-ray uses blue lasers, DVD-RAMs have concentric circles and DVD uses dual layering technology); it is not very probable you will see some of the more subtle points or actual examples being given.

Grade D/E students may give the fact that DVDs and Blu-ray use different coloured lasers to read and write the data; any thing beyond that is very unlikely.

- Blu-ray disks automatically come with a secure encryption system which helps to prevent piracy and copyright infringement.

Table 7.1 summarises the main differences between CDs, DVDs and Blu-ray.

Table 7.1

Disk type	Laser colour	Wavelength of laser light	Disk construction	Track pitch (distance between tracks)
CD	red	780 nm	single 1.2 mm polycarbonate layer	1.60 µm
DVD	red	650 nm	two 0.6 mm polycarbonate layers	0.74 µm
Blu-ray	blue	405 nm	single 1.1 mm polycarbonate layer	0.30 µm

DVD-RAM uses a very different technology to CDs and DVDs. They have the following features:

- instead of a single, spiral track, they use a number of concentric tracks
- use of concentric tracks allows simultaneous read and write operations to take place
- they allow numerous read and write operations (up to 100 000 times) and have great longevity (over 30 years) which makes them ideal for archiving.

Chapter 7

14 Use the words below to complete the following sentences. [3]

assembler compiler interpreter

To translate a program written in a high-level language, you can use a/an _____ or a/an _____ . To translate a program written in a low-level language you must use a/an _____ .

To translate a program written in a high-level language, you can use a compiler or an interpreter. To translate a program written in a low-level language you must use an assembler.

All students should be able to supply these definitions.

15

Program A

```
BEGIN
   VAR First, Second: INTEGER
   READ First, Second
   First:= First + Second
   WRITE First
END
```

Program B

```
INP
STA FIRST
INP
STA SECOND
LDA FIRST
ADD SECOND
STA FIRST
OUT
FIRST DAT
SECOND DAT
```

a) Which program is easier to understand? [1]

Program A

b) Why is it easier to understand? [1]

Program A is easier to understand because it uses English words.

c) Which program is written in a high-level language? [1]

Program A

A grade D/E student should be able to recognise these types of program and know which one is easier to understand. A grade B or C student should be able to give a reason as to why it is easier to understand. A grade A student should be able to provide a well-reasoned argument.

16 Give **three** advantages of writing a program in a high-level language rather than using a low-level language. [3]

A programmer can understand a program written in a high-level language more easily than a program written in a low-level language. This makes high-level language programs easier to debug and maintain. The development time for a program written in a high-level language is usually shorter than that of a similar program written in a low-level language.

A grade D/E student will not make comparisons, just statements, so question 16 won't be answered; the statements are likely to be vague and show no knowledge of high-level languages. A grade B/C student would make comparisons and there may be an attempt to place the answer within the context of reading and writing programs. A grade A student will show clear and specific comparisons between high- and low-level languages, detailing, for example the development time for similar programs.

17 Give **three** advantages of writing a program in a low-level language rather than using a high-level language. [3]

A program written in a low-level language takes up less space in memory than a similar program written in a high-level language. Also a program written in a low-level language usually has a faster execution time than a similar program written in a high-level language. Programs written in a low-level language can make direct use of specific hardware whereas programs written in a high-level language can only use routines already provided with the hardware.

A grade D/E student would find question 17 very challenging and would probably not attempt it. A grade B/C student would make comparisons and but probably won't make any attempt to place the answer in context. A grade A student will show clear and specific comparisons between low- and high-level languages, citing, for example, the faster execution time for similar programs.

18 Explain what a *compiler* does and what an *interpreter* does. In your explanation include a description of the differences between them. [2]

Compilers and interpreters translate high-level language programs.
Compilers translate all at once, interpreters translate line by line.

A grade D/E student may state what happens in question 18 but give no recognition that these are high-level language programs. A grade B/C student should make comparisons and state more precisely the role fulfilled by both a compiler and an interpreter. A grade A student should show the role of both a compiler and an interpreter and make clear comparisons between the two.

19 Choose which type of translator you would use to develop a program written in a high-level programming language. Give **three** reasons to support your choice. [4]

To develop a program I would use an interpreter for the following reasons:

1. *debugging is easier since the interpreter stops the execution of the program when an error is found*
2. *no need to wait for the program to recompile after an error has been corrected*
3. *program execution can start from the correction point.*

A grade D/E student would probably choose the right type of translator in question 19 but find giving reasons challenging. A grade B/C student may choose the right type of translator and there may be an attempt to provide reasons why. The reasons will probably be given in general terms and will need to be related to how the interpreter manages the translation. A grade A student will show clear and specific reasons that apply directly to the process of interpretation.

20 Look at these two pieces of code:

A

```
        CLC
        LDX #0
        LDA #0
loop1:  ADC B,X
        STA C
        INX
        CPX #A
        BNE loop1
```

B

```
        Sum = 0
        FOR Counter = 1 TO 10
        INPUT Number
        Sum = Sum + Number
        NEXT
        PRINT Sum
```

a) Which of these pieces of code is written in a high-level language? [1]

B

b) Discuss the benefits of writing code in a high-level language or a low-level language. [2]

High Level Languages are easier for a programmer to understand. Programs written in Low Level Languages can write directly to specific memory addresses.

c) There are **two** types of translator used with high-level languages.
Name each type of translator and describe **two** differences between them. [4]

Compiler and Interpreter. A compiler produces object code and an Interpreter does not. Interpreted code runs more slowly than compiled code.

A grade D/E student would probably choose the right code but would find providing the reasons for the benefits and differences more challenging. At this level, students often duplicate their answers by giving both sides of the same argument as different points. A grade B/C student may choose the right code and give two separate benefits but may only provide one difference. Grade A students will be more specific and show good understanding, providing two clear differences for part c.

Chapter 8

21 a) Name **three** security issues when using the internet and explain ways to overcome these issues. [6]

- Hacking
- Viruses
- Phishing
- Pharming
- Spyware/key logging software

Ways to overcome the above (must match up):

Hacking:
- firewalls
- use of strong passwords and user ids
- use of anti-hacking software.

Viruses:
- install anti-virus software
- don't use software from unknown sources
- be careful when opening emails/attachments from unknown senders.

Phishing:
- many ISPs filter out phishing emails
- the user should always be cautious when opening emails or attachments.

Pharming:
- some anti-spyware software can identify and remove the pharming code from the hard drive
- the user should always be alert and look out for clues that they are being redirected to another website.

Spyware/key logging software:
- use of anti-spyware software
- the user should always be alert and look out for clues that their keyboard activity is being monitored
- using a mouse to select characters from passwords (etc.) rather than typing them in using a keyboard can help reduce the risk.

Grade D/E students will be able to name three issues in part a (usually hacking, viruses and spyware) but the methods of overcoming these issues will be very sketchy. Mid-range students will probably mention phishing and/or pharming but will get the two terms confused. Those that stick to the 'easy' issues will probably gain most of the marks. Grade A/B students should find this all very straight forward and will probably embellish their methods of protection.

b) i Describe **two** ways to guard against accidental data loss.

- Use of back-ups in case the data is lost or corrupted through a hardware fault.
- Use of UPS (uninterruptable power supply) in case power loss causes hardware malfunction.
- Use of parallel systems as back-up hardware.
- Save data on a regular basis in case the software suddenly 'freezes' or 'crashes' whilst the user is working on it.
- Use of passwords and user ids to restrict access to authorised users only.

ii Firewalls are used to protect a user's computer. Describe **three** tasks carried out by a firewall. [5]

- To examine the traffic between a user's computer (or internal network) and a public network (e.g. the internet).
- Checks whether incoming or outgoing data meets a given set of criteria.
- If the data fails the criteria, the firewall will block the traffic and give the user (or network manager) a warning that there may be a security issue.

Students at A to C level will probably give most of the answers to part b shown here. Since only two ways to prevent accidental loss of data and three functions of a firewall are required, this shouldn't cause any major issues. Grade D/E students will probably get both of the marks in part i – use of back-ups/save data on a regular basis and use of passwords. Part ii, however, will give them problems and it will be rare to see more than one mark gained in this part.

- The firewall can be used to log all incoming and outgoing traffic to allow later interrogation by the user (or network manager).
- Criteria can be set so that the firewall prevents access to certain undesirable sites; the firewall can keep a list of all undesirable IP addresses.
- It is possible for firewalls to help prevent viruses or hackers entering the user's computer (or internal network).
- The user is warned if some software on their system is trying to access an external data source (e.g. automatic software upgrade); the user is given the option of allowing it to go ahead or request that such access is denied.

c) Describe what happens when a user logs on to a website which uses SSL protocols. [5]

The user's web browser sends a message so that it can connect with the required website which is secured by SSL.

↓

The web browser then requests that the web server identifies itself.

↓

The web server responds by sending a copy of its SSL certificate to the user's web browser.

↓

If the web browser can authenticate this certificate, it sends a message back to the web server to allow communication to begin.

↓

Once this message is received, the web server acknowledges the web browser, and the SSL-encrypted two-way data transfer begins.

Since 5 marks have been allocated in part c, only grade A students will potentially gain full marks; at the next level, expect to see only 3 to 4 marks maximum, and below that anything from 0 to 2. It won't be well answered, since some of the stages will be forgotten by the majority of students.

22 a) i What is meant by encryption?

Encryption uses a secret key which can be a combination of characters.

If this key is applied to a message, its content is changed which makes it unreadable unless the recipient also has the decryption key.

One key is needed to encrypt a message and another key is needed to decrypt a message.

ii What is meant by:
freeware
shareware? [4]

Freeware: this is software a user can download from the internet free of charge. Once it has been downloaded, there are no fees associated with using the software (examples include: Adobe Acrobat Reader, Skype or media players).

Unlike free software, freeware is subject to copyright laws and users are often requested to tick a box to say they understand and agree to the terms and conditions governing the software. This basically means that a user is not allowed to study or modify the source code in any way.

Shareware: in this case, users are allowed to try out some software free of charge for a trial period. At the end of the trial period, the author of the software will request that you pay a fee if you like it. Once the fee is paid, a user is registered with the originator of the software and free updates and help are then provided. Very often, the trial version of the software is missing some of the features found in the full version, and these don't become available until the fee is paid.

Obviously, this type of software is fully protected by copyright laws and a user must make sure they don't use the source code in any of their own software. Permission needs to be obtained before this software is copied and given to friends, family or colleagues.

b) i What is meant by asymmetric encryption?

A more secure method of encryption is to use asymmetric or public key encryption. A private key and a public key are both needed:

- a public key is made available to everybody
- a private key is only known by the computer user.

Both types of key are needed to encrypt and decrypt messages.

ii What is the benefit of using a 128-bit key rather than a 32-bit key? [3]

The larger the encryption key, the more difficult it is for someone to 'crack' it; thus security of data is increased the larger the encryption key used.

Grade E students are likely to answer the first part of part a correctly, but struggle with the second part, whereas a grade D student will probably answer one of them correctly, although they very likely to confuse freeware with free software. Grade A to C students will have no problems with part i but the full range of marks would be expected in part ii since the three types of software mentioned in the CIE syllabus can cause some confusion.

Grade D/E students may give the answer to part ii, but are unlikely to understand the differences between the terms encryption and asymmetric encryption. Students at A to C level should be able to answer both parts reasonably well with a full range of marks being seen.

c) Explain, with examples, the following terms:

i digital signatures

The digital signature system is based on public key encryption; it is a method used to ensure an electronic document is authentic; Figure 8.1 sums up what happens when user 'A' sends a message to user 'B'.

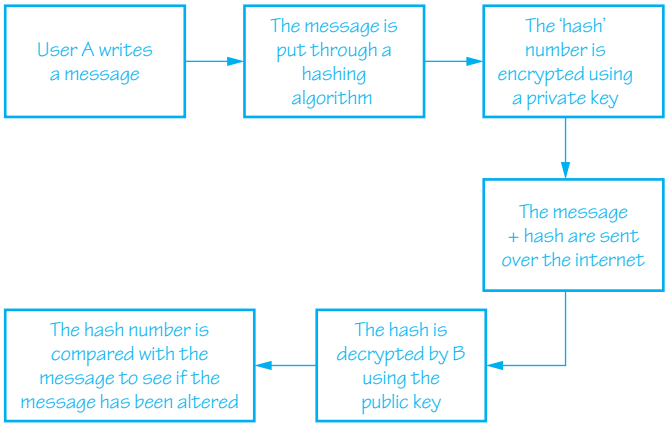


Figure 8.1

ii biometrics. [6]

Biometrics relies on the unique characteristics of human beings; examples include:

- fingerprint scans
- retina scans
- face recognition
- voice recognition.

Fingerprint scans

Images of fingerprints are compared against previously scanned fingerprints stored in a database; if they match then access is allowed; the system compares patterns of 'ridges' and 'valleys' which are fairly unique (accuracy is 1 in 500).

Retina scans

Retina scans use infra-red to scan the unique pattern of blood vessels in the retina (at the back of the eye); it is a rather unpleasant technique requiring a person to sit totally still for 10 to 15 seconds whilst the scan takes place; it is very secure since nobody has yet found a way to duplicate the blood vessel patterns (the accuracy is 1 in 10 million).

It is unlikely that any student other than grade A to B will give the kind of full answer shown for part c. Grade C students will probably give examples of biometrics but won't be able to explain how they function in a meaningful way. Likewise, grade D/E students won't be able to do anything other than name one or two examples of biometrics.