

Cambridge IGCSE[®] Computer Science Workbook Answers

● 1 Binary systems and hexadecimal

1 a 1 0 1 0 0 1 0 1

b A5 [3 marks]

2 a 118

b 95

c AC4

d 0 0 1 1 1 1 1 0 1 1 0 1 [6 marks]

3 a $800 \times 16 = 12800$ MB

b $\frac{22800}{1024} = 12.5$ GB [4 marks]

4 a i 0 1 0 0 0 0 0 1

ii 0 1 1 0 0 0 0 1 [2 marks]

b i 86

ii 118 [2 marks]

c i 0 1 0 1 0 1 1 0

ii 0 1 1 1 0 1 1 0 [2 marks]

d Lower case is always 32 higher than the upper case letter. Place a 1-bit in position 32 in the upper case binary ASCII code to get the lower case binary ASCII code. [2 marks]

5 a

0	0	1	0	0	0	0	1
---	---	---	---	---	---	---	---

[1 mark]

b i

1	0	0	0	0	1	0	0
---	---	---	---	---	---	---	---

[2 marks]

ii $128 + 4 = 132$ [1 mark]

c i R = 27 r = 108 (\times "R value" by 4)

ii M = 22 m = 88 (\times "M value" by 4) [4 marks]

6 a i 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. [2 marks]

ii Since it is much easier to work with:

B 5 A 4 1 A F C

rather than: 1 0 1 1 1 0 0 1 1 0 1 0 0 1 0 0 0 0 0
1 1 0 1 0 1 1 1 1 1 1 0 0

hexadecimal is often used when developing new software or when trying to trace errors in programs.

A program developer can look at each of the hexadecimal codes (as shown in Figure 1.7 of the textbook) and determine where the error lies. The value on the far left shows the memory location so that it is possible to find out exactly where in memory the fault occurs. [2 marks]

iii HTML code is often used to represent colours of text on the computer screen. The values change to represent different colours. The different intensity of the three primary colours (red, green and blue) is determined by its hexadecimal value. For example:

FF 00 00 represents primary colour red

00 FF 00 represents primary colour green

00 00 FF represents primary colour blue

[2 marks]

b www.H&Sstudybooks.co.uk [3 marks]

7 a AF01 [2 marks]

b 1 0 1 0 1 1 1 1 0 0 0 0 0 0 0 1 [2 marks]

8 a 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. [2 marks]

b Any two of:

- certain software used on mainframe systems need 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, otherwise the devices will be blocked if their MAC address does not adhere to the correct format
- to get past certain types of network restrictions it may be necessary to emulate unrestricted MAC addresses; hence it may require the MAC address to be changed on certain devices connected to the network. [2 marks]

- 9 a**
- paint levels low
 - spray gun switched off
 - yellow paint chosen. [3 marks]

b 1 0 0 1 1 1 0 0 [3 marks]

c i system totally switched off

ii error message [2 marks]

10

What is the denary value of the hexadecimal digit E?	10
What is the denary value of the binary number 00011100?	12
If the download speed for broadband is 64 megabits per second, how long would it take to download a 96 megabyte file (in seconds)?	14
If $2^x = 1$ terabyte (TB), what is the value of x?	16
What is the hexadecimal value of the denary number 50?	22
How many bits are there in two bytes of data?	28
	32
	40

[6 marks]

11 a i

Number	X	D	OUTPUT
220	220	128	
	92		1
	28	64	1
	-4	32	0
	28		
	12	16	1
	4	8	1
	0	4	1
	-2	2	0
	0		
	-1	1	0
	0		
		0.5	end

[4 marks]

ii

Number	X	D	OUTPUT
73	73	128	
	-55		
	73		0
	9	64	1
	-23	32	0
	9		
	-7	16	0
	9		
	1	8	1
	-3	4	0
	1		
	-1	2	0
	1		
	0	1	1
		0.5	end

[4 marks]

b Converts denary numbers into 8-bit binary numbers. [1 mark]

12 a i #FF 80 00

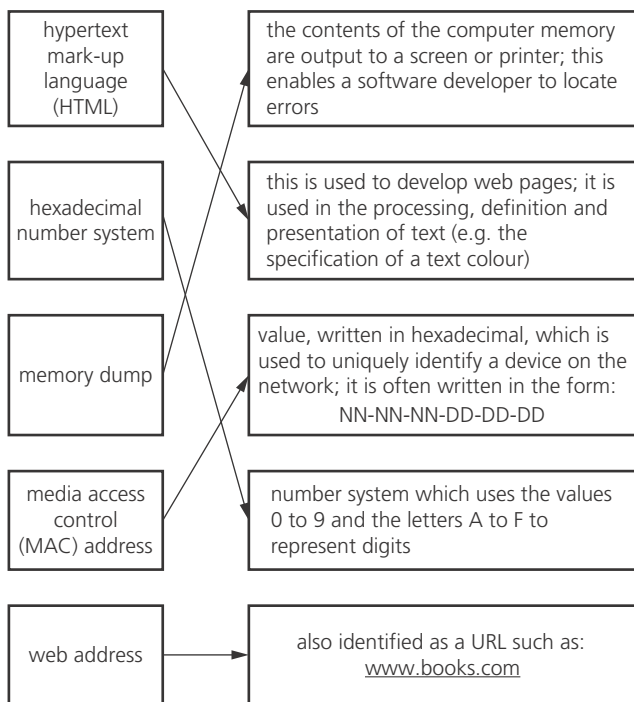
ii #B1 89 04 [2 marks]

b HyperText Mark-up Language (HTML) is used when writing and developing web pages. HTML is not a programming language but is simply a mark-up language. A mark-up language is used in the processing, definition and presentation of text (for example, specifying the colour of the text).

HTML uses <tags> which are used to bracket a piece of code; for example, <td> starts a standard cell in an HTML table, and </td> ends it. Whatever is between the two tags has been defined. [3 marks]

- c i $80 \text{ megabit/sec} = 10 \text{ MB/sec}$
 $\frac{650}{10} = 65 \text{ seconds}$ [2 marks]
 ii $16 \text{ megabit/sec} = 2 \text{ MB/sec}$
 $30 \times 15 = 450 \text{ MB}$
 $\frac{450}{2} = 225 \text{ seconds}$ [2 marks]

13



[5 marks]

- 14 a 9: 1 0 0 1
 6: 0 1 1 0 [2 marks]
 b 85
 705 [4 marks]
 c 9999 [1 mark]
 d 65535 [2 marks]
 e For example, representing each digit on a calculator or on a display board such as a digital clock. [1 mark]

- 15 The first method is a type of iterative process and the second method involves repetitive division.

Method 1

Consider the conversion of the denary number, 2004, into hexadecimal. This method involves placing hexadecimal digits in the appropriate position so that the total equates to 2004:

$$\begin{array}{r} 256 \quad 16 \quad 1 \\ 7 \quad D \quad 4 \end{array} \quad (\text{Note: } D = 13)$$

A quick check shows that: $(7 \times 256) + (13 \times 16) + (4 \times 1)$ gives 2004.

Method 2

This method involves successive division by 16. The remainders are then read from BOTTOM to TOP to give the hexadecimal value. Again using 2004, we get:

16	2004	
16	125	remainder: 4
16	7	remainder: 13
	0	remainder: 7

↑ read the remainder from top to bottom to get the hexadecimal number:
 7 D 4 (D = 13)

[7 marks]

2 Communication and internet technologies

- 1 a simplex, serial data transmission [2 marks]
 b full duplex, parallel data transmission [2 marks]
 c half duplex, serial data transmission [2 marks]
 2 a ● use of start bit
 ● use of stop bit
 ● data is between these two bits ...
 ● ... known as control bits [2 marks]
 b ● continuous stream of data
 ● timing signals sent using computer's internal clock
 ● allows data to be synchronised
 ● receiver counts number of bits and ...
 ● ... then reassembles them into the correct bytes of data [3 marks]
 c ● much faster data transmission rate than asynchronous
 ● if the timing is not accurate, data will be out of synch [2 marks]
 3 a universal serial bus [1 mark]
 b

Statement about USB connections	True (✓)
All the wires in a USB connector are used in data transmission	×
The maximum cable length in a USB connection is 2 metres	×
Devices plugged into the computer using the USB connection are automatically detected	✓
The USB connection has become the industry standard for most computers	✓
The user will always be prompted to download a device driver when the device is plugged in to the computer	×

[5 marks]

- c Any two of: printer, mouse, blue tooth transmitter/receiver, camera, external hard drive, ... [2 marks]

- 4 a i ✓
 ii ×
 iii × [3 marks]
- b They detect corrupted bits following data transmission. [1 mark]
- c i bit number = 4
 byte number = 6 [2 marks]
- ii column 4 (bit 4) has odd parity (five 1-bits)
 row 6 (byte 6) has odd parity (five 1-bits)
 where they intersect gives the incorrect bit [3 marks]
- iii 0 1 1 1 1 1 0 1 [1 mark]
- iv two bits interchanged (e.g. 1100 1100 became 1010 1100)
 several bits incorrect but parity stays the same (e.g. 1001 1001 became 1111 1001) [2 marks]
- v any description of ARQ, Checksum or Echo Check for 2 marks [2 marks]

5

Companies that provide the user with access to the internet; a monthly fee is usually charged for this service	Internet Service Provider (ISP)
A unique address that identifies the location of a device which is connected to the internet	Internet Protocol (IP) Address
A unique address that identifies the device that is connected to the internet	Media Access Control (MAC)
A set of rules that must be obeyed when transferring files across the internet	Hypertext Transfer Protocol
Software that allows a user to display a web page on their computer screen; they translate the HTML from the website	Web browser

[5 marks]

6 a Structure

- essential part of HTML document
- ... which includes semantics
- ... and structural mark-up

Presentation

- style of the document
- how document will look after translation
- css file [3 marks]

b https or the green padlock [1 mark]

7 a A [1 mark]

b <h1>, <h3>, <p>, <td> etc. (any two) [2 marks]

c Use of, for example, </h1> [1 mark]

d 1st two digits or letters = intensity of red
 2nd two digits or letters = intensity of green
 3rd two digits or letters = intensity of blue [1 mark]

e Hex(decimal) [1 mark]

3 Logic gates and logic circuits

- 1 a OR gate
 b NAND gate
 c XOR gate [3 marks]

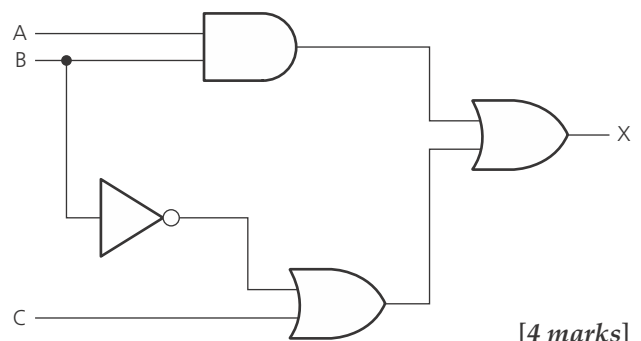
2

A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

[4 marks]

- 3 a $(A=1 \text{ AND } B=1) \text{ OR } (B=\text{NOT } 1 \text{ OR } C=1)$
 $(A \text{ AND } B) \text{ OR } (\text{NOT } B \text{ OR } C)$
 $(a.b) + (\bar{b} + c)$ [3 marks]

b



[4 marks]

4 a

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

[2 marks]

b OR gate [1 mark]

c less expensive
 faster development time [1 mark]

5 a

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

[4 marks]

b Input C only [1 mark]

6 a

A	B	C	X
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

[4 marks]

b AND gate

[2 marks]

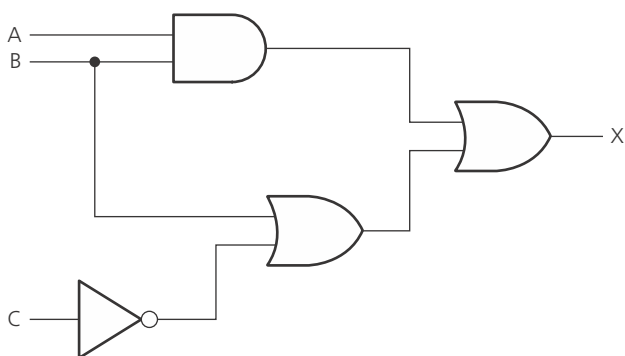
7 a $(A=1 \text{ AND } B=\text{NOT } 1) \text{ AND } (B=1 \text{ OR } C=1)$

$(A \text{ AND NOT } B) \text{ AND } (B \text{ OR } C)$

$(a.\bar{b}).(b+c)$

[3 marks]

b



[4 marks]

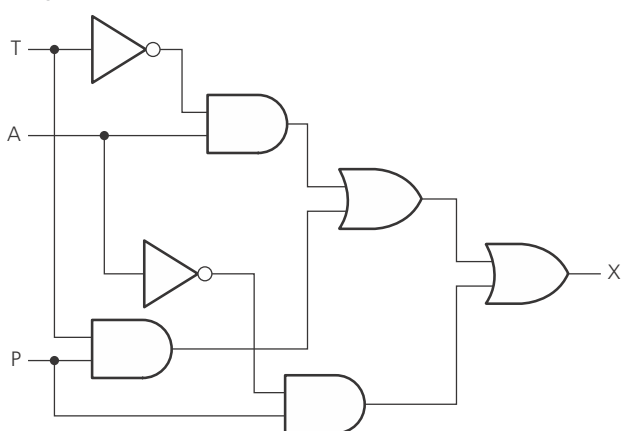
8 a $((T=\text{NOT } 1 \text{ AND } A=1) \text{ OR } (T=1 \text{ AND } P=1))$
OR $(A=\text{NOT } 1 \text{ AND } P=1)$

$((\text{NOT } T \text{ AND } A) \text{ OR } (T \text{ AND } P)) \text{ OR } (\text{NOT } A \text{ AND } P)$

$(\bar{T}.A + T.P) + (\bar{A}.P)$

[3 marks]

b



[7 marks]

c

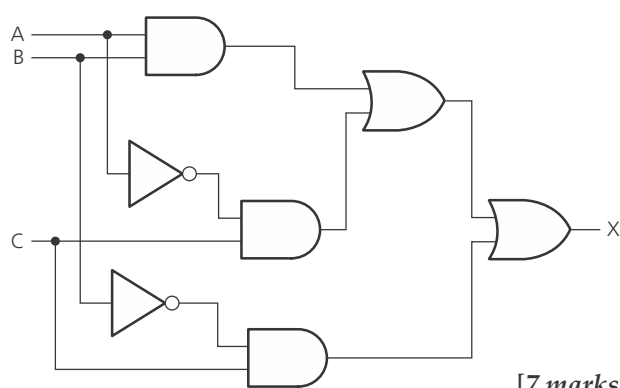
T	A	P	X
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

[4 marks]

9 a $((A=1 \text{ AND } B=1) \text{ OR } (A=\text{NOT } 1 \text{ AND } C=1))$
OR $(B=\text{NOT } 1 \text{ AND } C=1)$

$((A \text{ AND } B) \text{ OR } (\text{NOT } A \text{ AND } C)) \text{ OR}$
 $(\text{NOT } B \text{ AND } C)$

$(a.b + \bar{a}.c) + (\bar{b}.c)$



[7 marks]

b

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

[4 marks]

c

X	Y	Z	Q
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

[4 marks]

● 4 Operating systems and computer architecture

- 1 ● user interface
- multitasking
 - multiprogramming
 - batch processing
 - error handling
 - load/run applications
 - manage user accounts
 - file utilities (copy, save, etc.)
 - processor management
 - memory management
 - real-time processing
 - interrupt handling
 - security (log on, passwords, etc.)
 - input-output control

[6 marks]

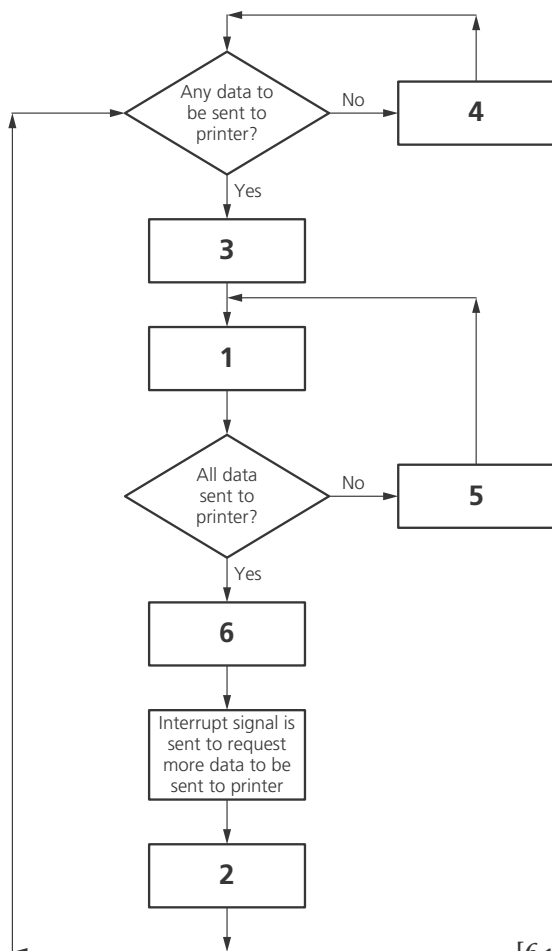
- 2 a hardware – e.g. printer out of paper
user – e.g. press <BREAK> key
software – e.g. can't find .exe file

[3 marks]

- b a temporary memory

[1 mark]

c



[6 marks]

- 3 a address (bus)
data (bus)
control (bus) [3 marks]

- b memory address register (MAR)
memory data register (MDR)
arithmetic and logic unit (ALU)
program counter (PC)
current instruction register (CIR) [3 marks]

c i MAR:

1	1	1	1	1	1	1	0
---	---	---	---	---	---	---	---

[2 marks]

MDR:

1	0	1	0	0	1	1	1
---	---	---	---	---	---	---	---

ii MAR:

1	0	0	0	0	1	0	0
---	---	---	---	---	---	---	---

MDR:

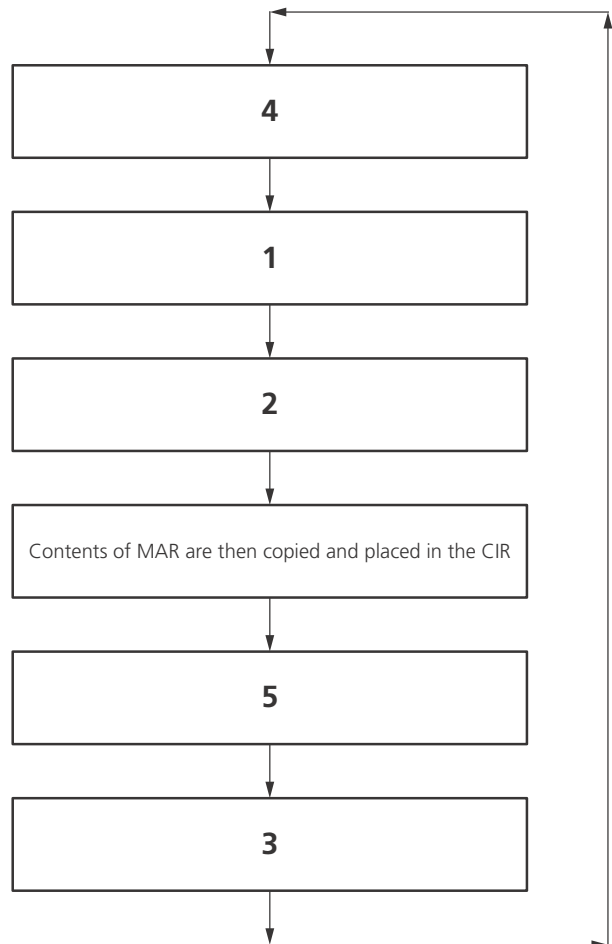
1	1	0	0	1	1	0	1
---	---	---	---	---	---	---	---

[2 marks]

iii 0011 1100

[1 mark]

4



[5 marks]

- 5 a simple tasks e.g. press button on a touchscreen tasks do not change [2 marks]
- b oven, microwave oven, washing machine, freezer, etc. [1 mark]

● 5 Input and output devices

- 1 ● passport data is scanned
- photograph in passport is scanned
 - digital camera also photographs the passenger
 - key items (such as width of nose) ...
 - ... from scanned passport photograph ...
 - ... are compared to digital camera image
 - if there is a match, passenger has been correctly identified. [4 marks]

2 CCD – charge couple device

- consists of a number of integrated circuits on a silicon structure
- made up of thousands of light-sensitive elements (pixels).

CT – computed tomography

- uses X-rays to split up solid object into thin slices

MRI – magnetic resonance imaging

- uses radio wave frequencies to split up a solid object into thin slices. [6 marks]

3 a A: 0 1 1 1 1 0 1

B: 0 1 0 1 1 1 1

C: 0 1 1 0 0 0 1 [3 marks]

- b ● keypad – to input number of items bought/ key in weights/ key in barcode number if barcode failed to scan correctly
- magnetic stripe reader – to read customer's credit/debit card
 - weighing machine – to weigh fresh goods
 - touchscreen – to select items such as fruit/ make other selections
 - barcode reader/scanner – to input/read barcode on an item
 - contactless screen – to allow payment by contactless debit cards
 - screen/monitor – to show cost of item bought/final bill/item description
 - speaker/beeper – makes beeping sound if barcode scans OK or if barcode fails to scan
 - printer – to output itemised bill [8 marks]

c Manager (any two of)

- easier/faster method of changing item prices
- better, more up-to-date sales information
- no need to price each item therefore saves time/money/errors
- allows for automatic stock control
- reduces risk of theft of items.

Customer (any two of)

- faster checkout/shorter queues at checkout
- reduces errors in adding up final bill/fewer pricing errors
- customer gets an itemised bill
- cost savings can be passed on to the customer
- better tracking of 'sell by' dates. [4 marks]

3 a Quick Response (code) [1 mark]

Any two of:

- b ● huge amount of data can be stored
- no need to manually enter web address/URL
 - simply scan QR code from magazine, advert, etc. [2 marks]
- c ● read QR code using mobile phone/tablet camera
- QR App on phone/tablet reads and interprets QR image
 - website *automatically* opens once the QR code is interpreted
 - other QR codes may contain information such as historic buildings, etc. [3 marks]

4 ● keyboard

- mouse/touchscreen
- microphone
- (2D) scanner
- interactive whiteboard. [5 marks]

5 a thermal bubble

- resistors create localised heat which makes ink vaporise
- tiny ink bubbles form which expand and some ink is ejected from print head onto paper
- when a bubble collapses, a vacuum is created
- vacuum allows fresh ink to be drawn into print head.

piezoelectric

- crystal located at rear of ink reservoir
- ... for each nozzle
- crystal given a charge which makes it vibrate

- vibration forces ink to be ejected on to paper
- at the same time, more ink is drawn in for further printing. [3 marks]

b advantages

- can take larger paper sizes such as A3
- more versatile; can print on T-shirts, paper, CD/DVDs and so on
- produces better colour images, e.g. for photos.

disadvantages

- slow at printing repeated copies
- expensive ink
- runs out of ink quickly (not suitable for large print jobs)
- has small paper tray. [2 marks]

c

Steps	Order
The printer driver checks whether the chosen printer is ready to print the document	3
Once the printer buffer is empty, the printer sends an interrupt to the processor requesting more data to be sent; this action continues until the whole document is printed	9
A sheet of paper is fed into the printer body; if no paper is available or the paper is jammed, an error message is sent to the computer	5
At the end of each full pass of the print head, the paper is advanced slightly to allow the next line to be printed	7
The printer driver ensures that the data is in a format that the chosen printer can process	2
Data is sent to the printer and is stored in a temporary memory, known as the printer buffer	4
Data from the document is first of all sent to the printer driver	1
As a sheet of paper is fed through the printer, the print head moves from side to side printing text/ image in the four colours	6
The whole process is continued until the printer buffer is empty	8

[8 marks]

- 6 a**
- Additive – object in printer is built up layer by layer
 - Direct 3D printing – uses inkjet technology where print head moves left to right and up and down to produce layers of the solid object
 - Binder 3D printing – this method uses two passes for each layer; first pass sprays dry powder and on second pass, sprays a binder (type of glue) to form a solid layer. [3 marks]
- b**
- use 3D scanner to scan an image of the part or use a blueprint, if available
 - image sent to software that prepares it for 3D printing

- solid object made from powdered plastic or metal
- object built up layer by layer (using one of the methods in part a). [3 marks]

- c**
- for making prosthetic limbs
 - allows precision reconstructive surgery (e.g. facial reconstruction)
 - aerospace, e.g. wings
 - fashion and art, e.g. sculptures, dresses, etc. [3 marks]

- 7 a**
- LEDs reach max brightness instantly
 - LEDs have a whiter light making colours more vivid
 - LEDs produce brighter light that improves colour definition
 - LEDs allow for thinner and lighter screens
 - LEDs last almost indefinitely
 - LEDs consume little power and therefore produce less heat. [3 marks]

- b i** organic light emitting diode [1 mark]

Any two of:

- ii**
- very flexible; can bend screen in an arc or even fold it up into small package
 - very bright (good picture definition)
 - does not need any back lighting unlike LCD screens; OLEDs produce own light
 - uses very little power
 - very large field of view; nearly 180°
 - very lightweight; OLED layers can be made from plastic rather than glass. [2 marks]

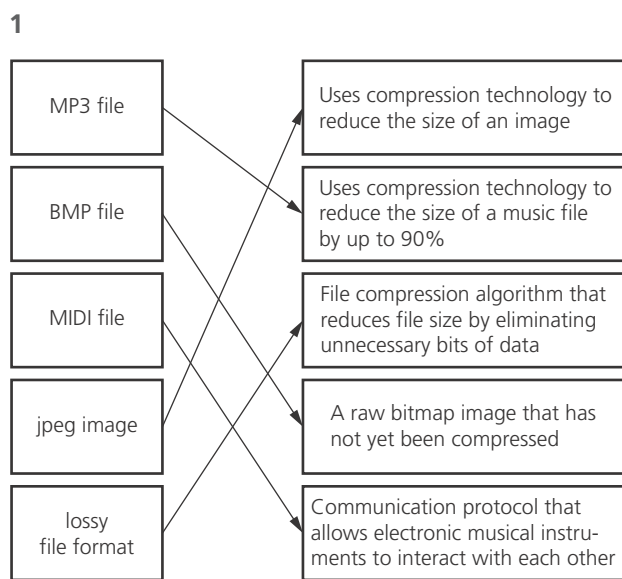
8

Sensor	Application
temperature	central heating system chemical processes (monitor or control) greenhouse temperatures fire alarm systems
light	switching street lights off and on <i>automatically</i> controlling/monitoring light levels in a greenhouse switching vehicle headlights on/off <i>automatically</i> pollution monitoring (check on turbidity of water)
infrared	<i>automatically</i> turn on/off a vehicle's windscreen wipers burglar alarm/intruder detection system automatic doors at a hotel/supermarket parking sensors on a vehicle
magnetic field	cell phones CD/DVD players anti-lock braking system on cars security systems

[4 marks]

- 9 ● owner activates alarm by keying in PIN/code
- pressure sensor detects intruder stepping on pressure pad/change in pressure if door or window opened
 - pressure sensor constantly sends data to the microprocessor
 - acoustic sensor detects noise such as breaking glass from a window or footsteps
 - acoustic sensor constantly sends data to the microprocessor
 - if data from sensors is analogue in nature, it is converted to digital using an ADC
 - microprocessor compares sensor readings with those pre-set values stored in memory
 - if pressure sensor reading > pre-set value, microprocessor sends signal to actuator ...
 - ... to operate buzzer/switch on security light
 - if acoustic sensor reading > pre-set value, microprocessor sends signal to actuator ...
 - ... to operate buzzer/switch on security light
 - buzzer continues to sound/security light stays on until reset by owner
 - if readings are within acceptable limits, then no action is taken
 - monitoring continues until owner deactivates system by keying in PIN/code. [7 marks]

● 6 Memory and data storage

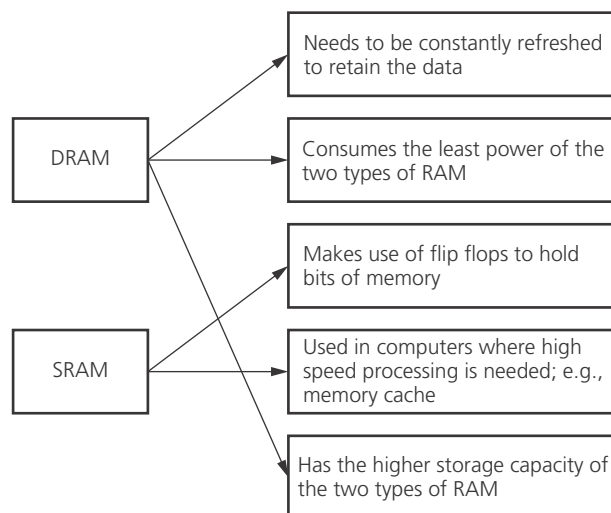


[5 marks]

- 2 a ● RAM is volatile; ROM is non-volatile
- RAM can be written to/read; ROM can only be read and not altered
 - RAM stores data/files/part of OS *currently* in use; ROM stores the bootstrap, BIOS.

[3 marks]

b



[5 marks]

- 3 a Real: e.g. 3.16
Integer: e.g. 5
Currency: e.g. \$15.40 [3 marks]
- b i 41 [1 mark]
ii '12 s3s y4 3 loss5 w4ld use 5 memory' [2 marks]
iii 27 [1 mark]
iv can get original sentence back if the code is known [1 mark]

4 a

Primary	Secondary	Off-line
RAM ROM	Fixed hard-disk drive (HDD) Fixed solid-state drive (SSD)	DVD-RAM Blu-ray disc Flash memory/memory stick (pen drive) Removable HDD

[6 marks]

- b ● more reliable; no moving parts to wear out
- much lighter in weight
 - does not have to 'get up to speed' before reading/writing
 - less power used so less heat generated
 - very thin since no mechanical moving parts
 - data access is faster than magnetic media.

[3 marks]

5 a

Optical media	Use red lasers to read/write	Use blue lasers to read/write	Use two polycarbonate layers	Use one polycarbonate layer	Track pitch < 1 µm	Track pitch > 1 µm
CD	✓			✓		✓
DVD	✓		✓		✓	
Blu-ray		✓		✓	✓	

[3 marks]

- b**
- blue laser means 'pits' and 'bumps' can be much smaller increasing storage
 - uses single polycarbonate disk removing risk of birefringence (light refraction)
 - comes with automatic secure encryption system
 - easier to manufacture since only uses one polycarbonate disk.
- [3 marks]
- 6**
- now store music in MP3 format/movies in MP4 format on smartphones/tablets, etc.
 - use of cloud to store movies and music files
 - use of streaming of music and videos from the internet
 - transfer of files now done using solid-state devices.
- [4 marks]

● 7 High- and low-level languages

- 1** A program is a list of instructions that enable a computer to perform a specific task. [2 marks]
- 2 a** High-level programming languages are portable as they can be used on different types of computer or with different operating systems.
- b** High-level programming languages are problem solving as when using this type of programming language a solution to a problem can be set out in a way that is understandable to human beings as well as a computer.
- c** Translation has to take place before a program written in a high-level programming language can be used by a computer as computers work in machine code. [3 marks]
- 3 1** Visual Basic
- 2** Python
- 3** Pascal
- 4** Java, etc. (there are many other correct answers)
- [4 marks]

- 4 1** Programs written in a high-level programming language are easier for a programmer to read and understand as the language used is closer to English.
- 2** Programs written in a high-level programming language are easier for a programmer to debug during development.
- 3** Development time is faster for a programmer when programs are written in a high-level programming language.
- 4** It is easier for a programmer to maintain a program written by another programmer when it is written in a high-level language. [4 marks]
- 5 a** Machine code is the binary language that a computer uses.
- b** Assembly language is a low-level programming language that requires translation before it can be used by a computer. [2 marks]
- 6 1** Programmers can write programs that make use of special hardware.
- 2** Programmers can write programs that make use of special machine-dependent instructions.
- 3** Programmers can write program code that does not take up much space in primary memory.
- 4** Programmers can write program code that performs a task very quickly. [4 marks]

7 a HLL

Sum := FirstNumber + SecondNumber

b LLL

```
LDA FirstNumber
ADD SecondNumber
STO Sum
```

c Hexadecimal

```
1 12
4 13
0 1A
```

d Binary

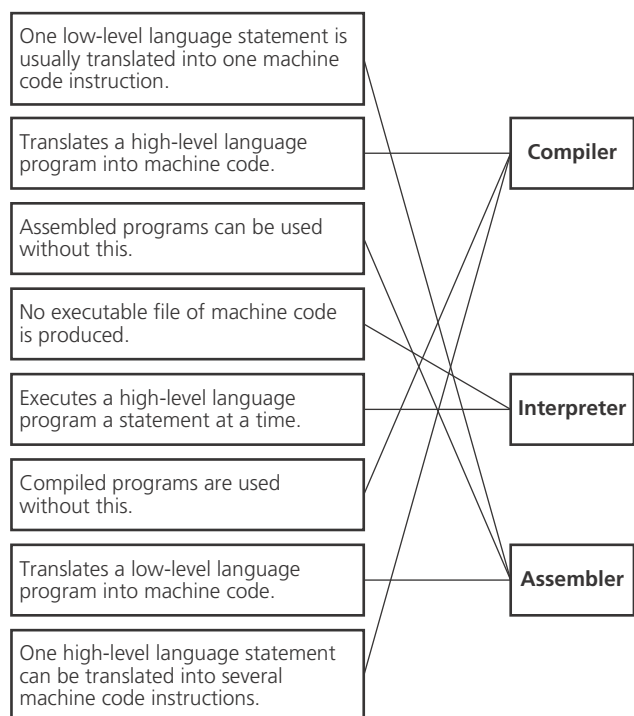
```
0001 00010010
0100 00010011
0000 00011010
```

[4 marks]

- 8 a** A translator is a program that turns a program written in a programming language, either high-level or low-level into a form that can be used by a computer. [2 marks]
- b 1** Assembler
- 2** Compiler
- 3** Interpreter [3 marks]

- c 1** An assembler is a computer program that translates a program written in a low-level language into a machine code program.
- 2** A compiler is a computer program that translates a program written in a high-level language into a machine code program.
- 3** An interpreter is a computer program that directly executes instructions written in a high-level programming language, without previously compiling them into a machine code program. [6 marks]
- 9 a** A syntax error is where a program statement does not obey the rules of the programming language. A program cannot be translated if it contains syntax errors. [2 marks]
- b** A logic error is where the program does not do what the programmer wanted it to do. Logic errors are found when a program is being run. [2 marks]
- c** When a compiler finds a syntax error, no translated program is produced. The error is added to a list of all the errors in the whole program, which is produced at the end of the attempted translation. [2 marks]
- d** When an interpreter finds a syntax error the programmer is alerted to the place in the program where the error was found. The error is then corrected by the programmer and the interpretation continues until the next error is found or the task is completed. [2 marks]

10



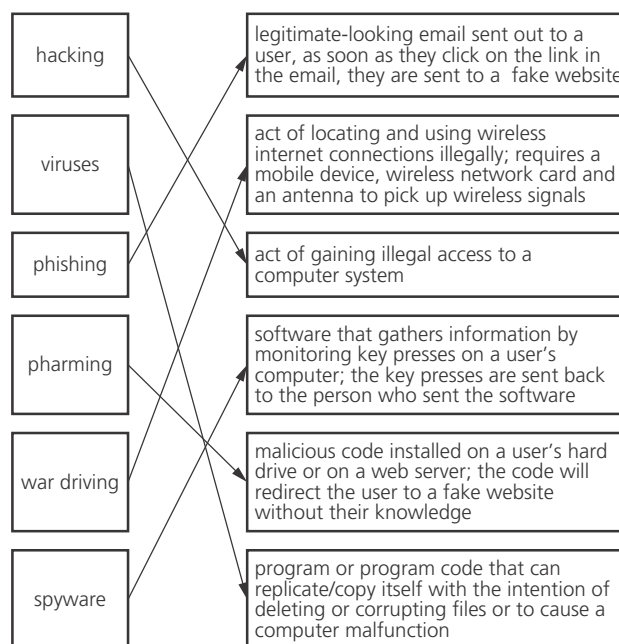
[8 marks]

- 11** An IDE is an Interactive/Integrated Development Environment; it usually includes a source code editor, build automation tools and a debugger. [2 marks]

- 12 a 1** More memory is required during compilation because the machine code program is held in main memory as well as the high-level language program.
- 2** Errors take longer to find as the whole program need to be edited and recompiled after every error.
- 3** Programs take longer to develop as the program needs to be restarted from the beginning when an error is found rather than continuing from where the error was once it has been corrected. [3 marks]
- b 1** Less memory is required when the program is run because the compiler is not held in main memory just the compiled program.
- 2** Program does not need to be re-compiled every time it is used unlike an interpreted program.
- 3** Program executes faster as statements are not re-translated every time. [3 marks]

8 Security and ethics

1



[6 marks]

- 2 a
- generated every time user visits a website
 - they collect key information/preferences about the user
 - can carry out user tracking, e.g. 'when customer bought X they also bought Y'
 - they form an anonymous user profile.

[3 marks]

- b
- examines traffic to/from user's computer
 - checks whether incoming/outgoing data meets given criteria
 - if criteria failed, traffic is blocked and user warned
 - logs all in/out traffic
 - can keep a list of acceptable websites or undesirable websites
 - can help to prevent viruses or hacking
 - warns user if software on their system tries to access external sources (e.g. automatic upgrades).

[3 marks]

- c
- back up files on a regular basis
 - save data regularly
 - use passwords and user ids to restrict access
 - use UPS to prevent power loss and reduce risk of data corruption
 - use parallel systems as back-ups
 - correct training procedures to reduce incorrect operation of equipment (e.g. correct shut-down procedures).

[3 marks]

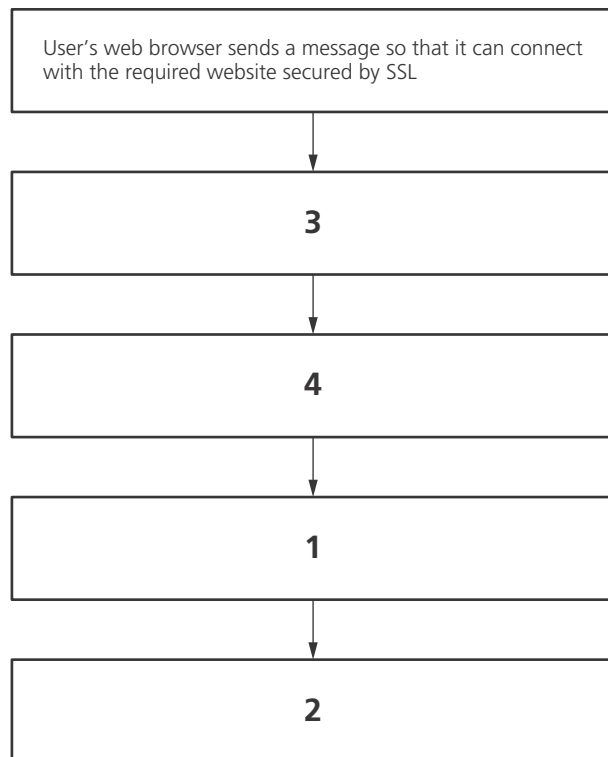
- 3 a
- SSL: secure sockets layer
 - TLS: transport layer security
 - type of protocol when communicating on a network, e.g. internet
 - SSL/TLS encrypts data
 - use of https and the green padlock to indicate secure websites.

[3 marks]

- b
- TLS can be extended with newer authentication methods
 - uses session caching (can resume an existing TLS session)
 - separates the handshaking process from the record protocol.

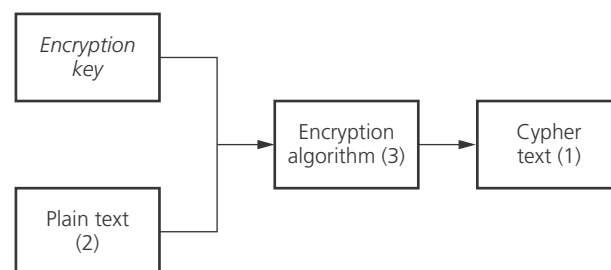
[2 marks]

c



[4 marks]

4 a



[3 marks]

- b i **hashing algorithm** takes message or key and translates it into a string of characters usually shown in hex; makes message/key nearly impossible to read if intercepted illegally
- ii **encryption algorithm** converts message using encryption key into 'meaningless' text; same key is used to decrypt the message
- iii **MD4 system** example of hashing algorithm that generates 128-bit string (32 hex digits) whenever a value is run through it
- [3 marks]
- c
- gives more combinations
 - 128 bits gives 10^{38} combinations; 56 bits gives 10^{16} combinations
 - greater number of bits then greater security since harder to crack
 - greater the key size, greater the security of the encryption system.

[2 marks]

- 5 a**
- attempt to prevent users from accessing part of a network
 - can affect network or individual users
 - can prevent user from accessing emails, websites or online services
 - can be done by flooding the network with useless traffic
 - ... or by the attacker flooding the user's email account with spam. [2 marks]
- b**
- use an up-to-date virus checker
 - use a firewall to restrict traffic
 - apply email filters. [2 marks]
- c**
- network performance slows down
 - inability to access certain websites
 - large volumes of spam in the inbox. [2 marks]
- 6**
- unique 10- or 12-digit code supplied to customer
 - key in 'random' digits/characters from the PIN and/or password
 - use of TAN; device where card is inserted and an eight-digit code is generated that changes every time the device is used
 - use of drop-down boxes to enter digits/characters from PIN or password; this is an attempt to defeat spyware/key logging software
 - personal questions such as mother's maiden name, phone numbers, etc.
 - not allowed to use browser navigation buttons when logged in to bank's website; this prevents users using the same computer from accessing web pages from a previous user. [5 marks]

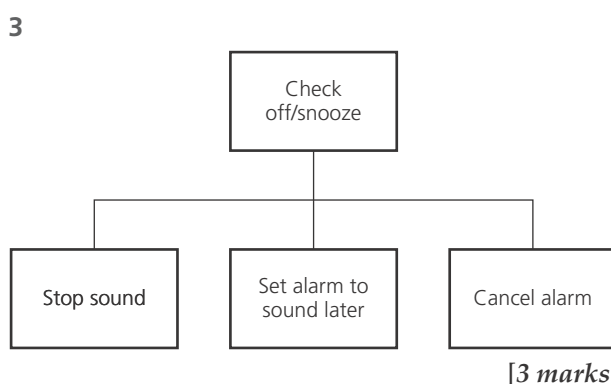
7

Description	Term
Set of principles set out to regulate the use of computers and computer systems	(computer) ethics
The taking of another person's idea or work and claiming it as their own work without any acknowledgement to the originator	plagiarism
Software a user can download from the internet free of charge; once downloaded, there are no fees when using it; however, it is subject to copyright laws	freeware
Software that users are allowed to try out free of charge for a trial period; at the end of the trial period, users will be requested to pay a fee if they want to continue using it	shareware
Users have freedom to run, copy, change or adapt this software without the need to seek permission; the software is not protected by copyright but there are still some restrictions	free software

[5 marks]

9 Problem-solving and design

- 1** A computer system is made up of
- hardware
 - software
 - data
 - communications
 - people. [5 marks]
- 2** The breaking down of a computer system into its sub-systems, then breaking the sub-systems into smaller sub-systems until each sub-system is a single action. [3 marks]



- 4** Description: A routine that has been written and tested that is already compiled and ready for use by other programmers.
- Example: The 'Save as' DLL in windows. [3 marks]
- 5 a** An algorithm is a set of steps to complete a task. [2 marks]

- b**
- 1** flowchart
- 2** pseudocode [2 marks]

- 6** Normal test data – data that are accepted and used to prove that a program works correctly.
- Abnormal/erroneous test data – data that are rejected by a program, usually with an error message.
- Extreme test data – data that are the largest and smallest values accepted by a program.
- Boundary test data – data used to establish where the boundary is; for example, at an upper bound the highest value accepted and the lowest value rejected. [6 marks]
- 7** Explanation: All the items of data required to work through the section of program being tested.

Example: A routine that found the average temperature for a week, where readings were taken daily, would require seven items of test data, e.g. 12, 13, 11, 12, 14, 13, 13. [3 marks]

8 a Validation is an automated check that data is reasonable, whereas verification is a human check that the data has no mistakes that occurred while being entered. [2 marks]

b 1 Range check

2 Type check [2 marks]

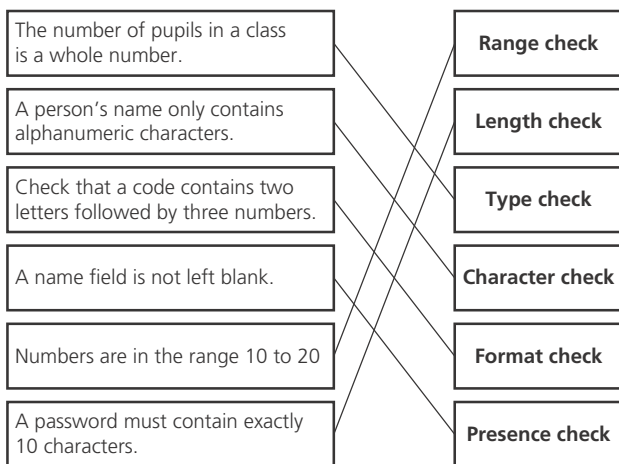
c 1 Double entry.

2 On-screen check. [2 marks]

9 Range check: Checks that values are within a lower and an upper bound; for example, percentage marks for an examination must be greater than or equal to zero and less than or equal to one hundred. [3 marks]

Format check: Checks that characters conform to a given pattern; for example, the code to identify a teaching group could be XXXnn, where XXX are the teacher's initials and nn is a two-digit number. [3 marks]

10



[5 marks]

11 a A check digit is the final digit in a code that is calculated using the other digits. [2 marks]

b 9780 7487 8296 3

Stage 1 $49 = 9 + 8 + 7 + 8 + 8 + 9$

Stage 2 $78 = (7 + 0 + 4 + 7 + 2 + 6) \times 3$

Stage 3 $\frac{127}{10}$ gives remainder 7

Stage 4 check digit is $3 = 10 - 7$

Correct [3 marks]

c $1127 \ 18 = 1 \times 4 + 1 \times 3 + 2 \times 2 + 7 \times 1$

$\frac{18}{11} = 1$ remainder 7

check digit is $4 = 11 - 7$ [2 marks]

$47857 \ 89 = 4 \times 5 + 7 \times 4 + 8 \times 3 + 5 \times 2 + 7 \times 1$

$\frac{89}{11} = 8$ remainder 1

check digit is x as $10 = 11 - 1$ [2 marks]

12 a Marks must be between zero and 100 inclusive. [2 marks]

b minus one [1 mark]

c

Sum	Reject	Mark	Output
0	0		
17		17	
52		35	
76		24	
	1	-5	
76		0	
143		67	
225		82	
322		97	
	2	-21	
367		45	
390		23	
		-1	390 2

[4 marks]

d Actions are not repeated unnecessarily, there are no unnecessary processes but the algorithm needs to reject any non-numeric values. [3 marks]

● 10 Pseudocode and flowcharts

1 Age = 21

Name = Richard

Value = 36

Sum = 57

Flag = True

[5 marks]

2 IF ... THEN ... ELSE ... ENDIF

IF Age = 10

THEN PRINT 'Selected'

ENDIF

IF Age = 20

THEN PRINT 'Selected'

ENDIF

Or

IF Age = 10

THEN PRINT 'Selected'

ELSE

IF Age = 20

THEN PRINT 'Selected'

ENDIF

ENDIF

[3 marks]

CASE ... OF ... OTHERWISE ... ENDCASE

CASE Age OF

10: PRINT 'Selected'

20: PRINT 'Selected'

OTHERWISE

ENDCASE

[3 marks]

3 a FOR ... TO ... NEXT

REPEAT ... UNTIL

WHILE ... DO ... ENDWHILE

b i Total ← 0

FOR Count ← 1 TO 10

INPUT Number

Total ← Total + Number

Next Count

Print Total

[6 marks]

ii Total ← 0

INPUT Number

WHILE number <> -1

Total ← Total + Number


```

    INPUT Number
ENDWHILE
Print Total

```

[6 marks]

iii Total \leftarrow 0

```

REPEAT
    INPUT Number
    Total  $\leftarrow$  Total + Number
UNTIL Total > 20
Print Total

```

[6 marks]

4 a INPUT

READ [2 marks]

b OUTPUT

PRINT [2 marks]

```

5 IF StockLevel < 10
    THEN PRINT 'Reorder'
ENDIF

```

[2 marks]

6 a Total \leftarrow 0

CountPositive \leftarrow 0

FOR Count \leftarrow 1 TO 20

INPUT Number

IF Number > 0

THEN

Total \leftarrow Total + Number

CountPositive \leftarrow CountPositive + 1

ENDIF

NEXT Count

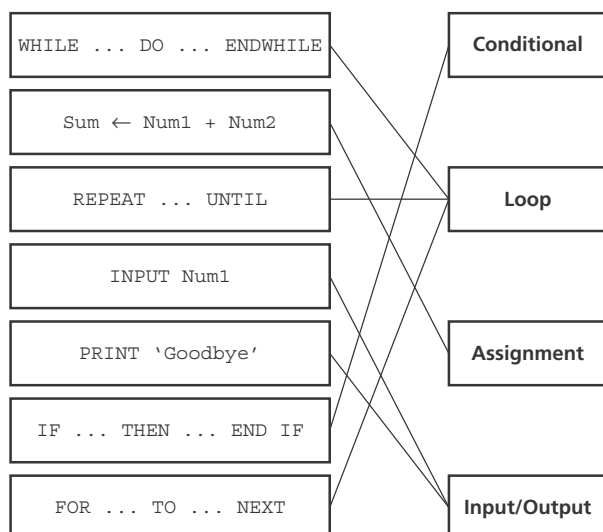
Average \leftarrow Total/CountPositive

PRINT 'Average of the Positive numbers is ', Average [7 marks]

b Put the input statement in a Repeat Until loop that rejects any number less than zero.

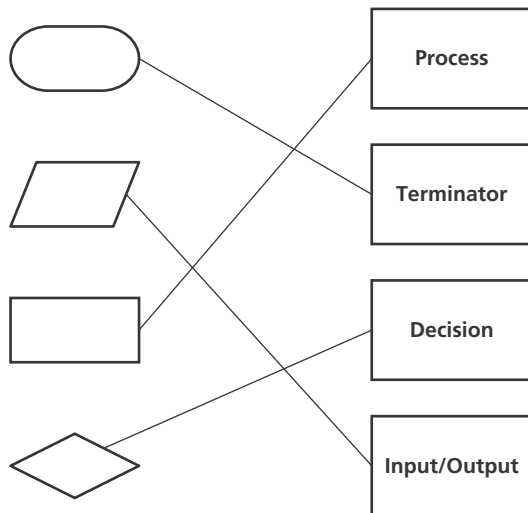
[2 marks]

7



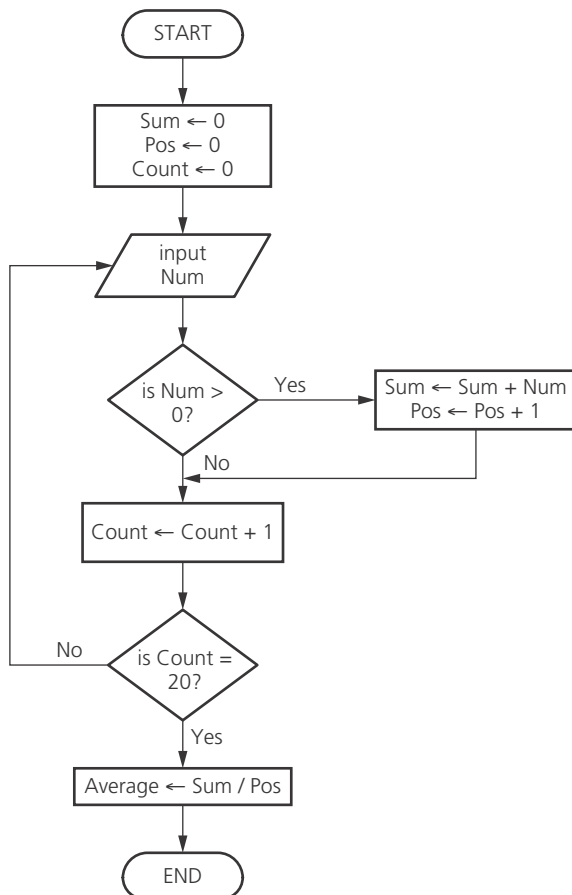
[7 marks]

8



[3 marks]

9 a

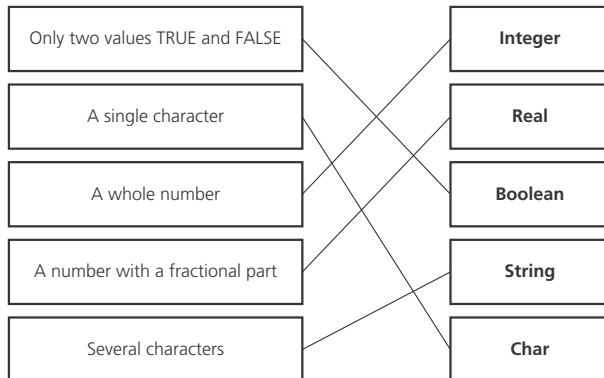


[7 marks]

b Change the first test to ≥ 0 and ≤ 100 , check if Count = 30. [3 marks]

● 11 Programming concepts

1



[4 marks]

- 2 A variable should be used when the value will change while the program is running; for example, a counter will change. `Count ← Count + 1`

A constant should be used when the value will not change while the program is running; for example, the highest mark that could be awarded for an exam will not change. This could be declared as a constant `const TopMark = 100;` (JavaScript) or declared by assignment `ConstTopMark = 100` (Python).

Note: You should answer this in the context of the programming language you have been taught. [4 marks]

- 3 a Average Mark, variable changes when new marks have been added.
 b Number of months in a year, constant, always has the same value.
 c Number of pupils in a class, constant or variable, need more information to decide. [6 marks]

- 4 a i

```
Number = int (0)
Count = int (0)
Sum = int (0)
for Count in range (1, 9):
    Number = int(input( "Enter a Whole Number: "))
    Sum = Sum + Number
print ("Sum of eight numbers is ", Sum)OUTPUT.
(Python)
```
- ```
<HTML>
<HEAD>
<TITLE> 4 (a) (i)</TITLE>
<SCRIPT LANGUAGE = "JavaScript">
var Number = 0;
var Count = 0;
var Sum = 0;
do
{
 Number = window.prompt('Enter whole number ', '');
 Number = parseInt (Number);
 Sum = Sum + Number;
```

```

 Count = Count + 1
 }
while (Count < 8);
document.write('Sum of eight numbers is ', Sum)
</SCRIPT>
</HEAD>
<BODY>
</BODY>
</HTML>
(JavaScript)

```

**Note:** You should answer this in the context of the programming language you have been taught. Above are examples only. There are many correct answers.

[6 marks]

ii `Number = int (0)`

```

Sum = int (0)
Number = int(input("Enter a Whole Number: "))
while Number != -1:
 Sum = Sum + Number
 Number = int(input("Enter a Whole Number: "))
print("Sum of the numbers is ", Sum)
(Python)

```

```

<HTML>
<HEAD>
<TITLE> 4 (a) (ii) </TITLE>
<SCRIPT LANGUAGE = "JavaScript">
var Number = 0;
var Count = 0;
var Sum = 0;
do
{
 Number = window.prompt ('Enter whole number ', '');
 Number = parseInt (Number);
 Sum = Sum + Number;
}
while (Number != -1);
document.write('Sum of the numbers is ', Sum + 1)
</SCRIPT>
</HEAD>
<BODY>
</BODY>
</HTML>
(JavaScript)

```

**Note:** You should answer this in the context of the programming language you have been taught. Above are examples only. There are many correct answers.

[6 marks]

```
iii Number = int (0)
Sum = int (0)
Number = int(input("Enter a Whole Number: "))
while (Sum + Number) <= 10:
 Sum = Sum + Number
 Number = int(input("Enter a Whole Number: "))
print("Sum of the numbers is ", Sum)
(Python)
```

```
<HTML>
<HEAD>
<TITLE> Question 4 (a) (iii)</TITLE>
<SCRIPT LANGUAGE = "JavaScript">
var Number = 0;
var Count = 0;
var Sum = 0;
do
{
 Number = window.prompt ('Enter whole number ', '');
 Number = parseInt (Number);
 Sum = Sum + Number;
}
while (Sum < 10);
document.write('Sum of the numbers is ', Sum - Number)
</SCRIPT>
</HEAD>
<BODY>
</BODY>
</HTML>
(JavaScript)
```

**Note:** You should answer this in the context of the programming language you have been taught. Above are examples only. There are many correct answers.

[6 marks]

- b i** 2, 4, 3, 1, 10, 3, 2, 1  
**ii** 4, 9, 3, -1  
**iii** 2, 3, 7

**Note:** These are examples only. There are many correct answers.

[3 marks]

- c** Need to change declarations to real and use float/parseFloat for input.

[2 marks]

```
5 a Number = int (0)
Sum = int (0)
NegCount = int (0)
Count = int(0)
Average = float (0)
for Count in range (1, 11):
```

```

 Number = int(input("Enter a Negative Number: "))
 if Number < 0 :
 Sum = Sum + Number
 NegCount = NegCount + 1
Average = Sum / NegCount
print ("Average of the negative numbers is ", Average)
(Python)

<HTML>
<HEAD>
<TITLE>Question 5
</TITLE>
<SCRIPT LANGUAGE = "JavaScript">
var Number = 0;
var Count = 0;
var Sum = 0;
var NegCount = 0;
var Average = 0.0;
for (var Count = 1; Count <= 10; Count = Count + 1)
{
 Number = window.prompt('Enter a negative number ', '');
 Number = parseInt (Number);
 if (Number < 0)
 {
 Sum = Sum + Number;
 NegCount = NegCount + 1
 }
}
Average = Sum / NegCount;
document.write('Average of negative numbers is ', Average)
</SCRIPT>
</HEAD>
<BODY>
</BODY>
</HTML>
(JavaScript)

```

**Note:** You should answer this in the context of the programming language you have been taught. Above are examples only. There are many correct answers. [7 marks]

- b** Put the input statement inside a WHILE loop that rejects positive numbers. [2 marks]
- c** -1, -9, 2, 2, 2, 2, 2, 2, 2

**Note:** These are examples only. There are many correct answers. [1 mark]

## ● 12 Data structures: arrays and using pre-release material

1 Name – the name identifying the array

Size – the number of elements in the array

Element – each item in an array is called an element

Index – the index number identifies the position of an element in the array

Type – all elements in an array have the same data type

Dimension – the organisational structure of the array: 1D is a list; 2D is a table

[6 marks]

2 An array is used to store items of the same type so that the data can be manipulated easily; for example, a list of marks can be searched to find the highest mark.

[3 marks]

3 a StudentName = []  
or

var StudentName = new Array (30);

b StudentMarkTest1 = array.array ("i", range (200))  
or

var StudentMarkTest1 = new Array (200);

c Enrolled = []  
or

var Enrolled = new Boolean (20);

[3 marks]

4 a i import array

ConstNoDays = int(8)

Enquiries = array.array ("i", range (ConstNoDays))

Counter = int(0)

for Counter in range (1, ConstNoDays):

    Enquiries[Counter] = int(input("Please Enter number of enquiries "))

for Counter in range (1, ConstNoDays):

    print ("Day ", Counter, " Enquiries ", Enquiries [Counter])

(Python)

<HTML>

<HEAD>

<TITLE> Chapter 12 Question 4 (a)(i)</TITLE>

<SCRIPT LANGUAGE = "JavaScript">

const NoDays = 7;

var Enquiries = new Array (NoDays + 1);

for (var Counter = 1; Counter <= NoDays; Counter = Counter + 1)

{

    Enquiries[Counter] = parseInt(window.prompt('Enter number of enquiries ', ''));

}



```

for (var Counter = 1; Counter <= NoDays; Counter = Counter + 1)
{
 document.write('Day ' + Counter, ' has ' + Enquiries[Counter] + ' enquiries.' + '
')
}
</SCRIPT>
</HEAD>
<BODY>
</BODY>
</HTML>
(JavaScript)

```

**Note:** You should answer this in the context of the programming language you have been taught. Above are examples only. There are many correct answers.

[6 marks]

ii import array

```

ConstNoDays = int(8)
Most = 0
Least = 1000
MostDay = 0
LeastDay = 0
Enquiries = array.array ("i", range (ConstNoDays))
Counter = int(0)
for Counter in range (1, ConstNoDays):
 Enquiries[Counter] = int(input("Please Enter number of enquiries "))
 if Most < Enquiries[Counter]:
 Most = Enquiries[Counter]
 MostDay = Counter
 if Least > Enquiries[Counter]:
 Least = Enquiries[Counter]
 LeastDay = Counter
print ("Day ", LeastDay, " has the least number of enquiries ", Least)
print ("Day ", MostDay, " has the most number of enquiries ", Most)
(Python)

```

```

<HTML>
<HEAD>
<TITLE> Chapter 12 Question 4 (a)(ii)</TITLE>
<SCRIPT LANGUAGE = "JavaScript">
const NoDays = 7;
var Most = 0;
var Least = 1000;
var MostDay = 0;
var LeastDay = 0;
var Enquiries = new Array (NoDays + 1);

```

```
for (var Counter = 1; Counter <= NoDays; Counter = Counter + 1)
{
 Enquiries[Counter] = parseInt (window.prompt('Enter number of enquiries ', ''));
 if (Most < Enquiries[Counter])
 {
 Most = Enquiries[Counter];
 MostDay = Counter
 }
 if (Least > Enquiries[Counter])
 {
 Least = Enquiries[Counter];
 LeastDay = Counter
 }
}

document.write('Day ' + MostDay, ' has most enquiries ' + Most + '
');
document.write('Day ' + LeastDay, 'has least enquiries ' + Least + '
')
</SCRIPT>
</HEAD>
<BODY>
</BODY>
</HTML>
```

(JavaScript)

**Note:** You should answer this in the context of the programming language you have been taught. Above are examples only. There are many correct answers. **[6 marks]**

```
iii import array
ConstNoDays = int(8)
Most = 0
Least = 1000
MostDay = 0
LeastDay = 0
Total = 0
Average = 0
Enquiries = array.array ("i", range (ConstNoDays))
Counter = int(0)
for Counter in range (1, ConstNoDays):
 Enquiries[Counter] = int(input("Please Enter number of enquiries "))
 Total = Total + Enquiries[Counter]
Average = Total/7
print ("Total ", Total)
print ("Average ", Average)
(Python)
```

```

<HTML>
<HEAD>
<TITLE> Chapter 12 Question 4 (a)(iii)</TITLE>
<SCRIPT LANGUAGE = "JavaScript">
const NoDays = 7;
var Total = 0;
var Average = 0.0;
var Enquiries = new Array (NoDays + 1);
for (var Counter = 1; Counter <= NoDays; Counter = Counter + 1)
{
 Enquiries[Counter] = parseInt(window.prompt('Enter number of enquiries ', ''));
 Total = Total + Enquiries[Counter]
}
Average = Total/NoDays;
document.write('Total ' + Total, '
');
document.write('Average ' + Average, '
')
</SCRIPT>
</HEAD>
<BODY>
</BODY>
</HTML>
(JavaScript)

```

**Note:** You should answer this in the context of the programming language you have been taught. Above are examples only. There are many correct answers. [6 marks]

**b** 2, 4, 3, 1, 10, 3, 2,

**Note:** Above are examples only. There are many correct answers. [1 mark]

**Note:** The answers to questions 5, 6, 7 and 8 will depend upon the pre-release material that you are using. This changes for every exam.

## ● 13 Databases

- 1 1 No duplication of data
- 2 Changes need only be made once
- 3 No inconsistency of data, everyone sees and uses the same data [3 marks]

2 Table – a set of related data elements stored in rows and columns.

Record – the data contained in a table about a single item.

Field – a single unit of data in a record containing one specific piece of information.

Primary key – a field in a record where the data held is unique for each record stored. [4 marks]

- 3 a**
- |              |                |           |
|--------------|----------------|-----------|
| TextBookName | Text           |           |
| ISBN         | Text           |           |
| Author       | Text           |           |
| Copies       | Integer/Number |           |
| Subject      | Text           | [5 marks] |

- b i** TextBookName, Author, Subject\*  
**ii** ISBN, Copies, Subject\* [2 marks]

\*could appear in either but not both

- c** ISBN, unique for each identified text [2 marks]

- d** Copies, range check between 1 and 50\*  
 ISBN, check digit  
 (Subject, select from list) [4 marks]  
 \*any suitable number

**e**

Field:	Subject	Copies	TextBookName
Table:	TEXTBOOK	TEXTBOOK	TEXTBOOK
Sort:			
Show:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Criteria:	= 'History'	>= 30	
or:			

**4 a**

Field:	No of countries	Head office	Code
Table:	OILCO	OILCO	OILCO
Sort:			
Show:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Criteria:	< 30	= 'Americas'	
or:			

[3 marks]

**b**

Field:	Number in stock	Items ordered	Item code
Table:	SHOP	SHOP	SHOP
Sort:			
Show:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Criteria:	<[Re-order level] = Yes		
or:			

[3 marks]

**5 a**

Field:	Profits (billion \$)	Share price (\$)	Name of company
Table:	OILCO	OILCO	OILCO
Sort:			
Show:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Criteria:	> 8		
or:		< 50	

[3 marks]

**b**

Field:	Price of item (\$)	Value of stock (\$)	Item code
Table:	SHOP	SHOP	SHOP
Sort:			
Show:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Criteria:	>2		
or:		>300	

[3 marks]