

M1.

- (a) 0111 1011; 1
- (b) $256 // 2^8$; 1
- (c) 7;B; 2
- (d) Easier for people to read / understand;
(Can be displayed using) fewer digits;
More compact when printed/displayed;
NE Takes up less space
NE More compact Max 1

[5]

M2.

- (a) 00011011;
1;1101101; 3
- (b) 10000;1000; Allow FT from (a)
Stop marking when an error occurs 2
- (c) (i) Carry Bit;
R Overflow bit 1
- (ii) For multi-word/byte operations//test for overflow 1
- (d) 1B;
ED;
Allow FT 2

[9]

M3.

- (a) **All marks AO2 (apply)**

1 mark for working: conversion of D to 13 or multiplication of a number (even if not 13) by 16 and adding 6 to the result;
1 mark for answer: 214; 2
- (b) **All marks AO2 (apply)**

1001; 0110;
1 mark: correct first four bits
1 mark: correct bits in position 5 – 8 2

(c) **All marks AO2 (apply)**

1;0111101;

2 marks: Correct answer only

2

(d) **Mark is for AO2 (apply)**

10101011;

1

(e) **Mark is for AO1 (understanding)**

The result is too large to be represented;
(it causes) overflow;

The result represents a negative value;

Max 1 mark

1

[8]

M4.

(a) 167;

1

(b) $10.4375 // 10 \frac{7}{16} ::$

1 mark for correct integer part

1 mark for correct fractional part

2

(c) -;89;

1 mark for correct sign

1 mark for correct integer value

2

(d) A7;

1

[6]

M5.

(a) (i) Any whole number. There should be no decimal point.

1

(ii) Any number with a decimal point

1

(iii) $1101.11 = 8 + 4 + 1 + \frac{1}{2} + \frac{1}{4}$

$=13.75 (13 \frac{3}{4})$

1 mark for complete working, 1 mark for answer

2

- (b) B7 3E 1
- (c) To represent the address / contents of a location;
 Error messages;
 In assembly language programs;
 HTML property values;
 It is easier to absorb / understand a large number in hex than as a long sequence of 1s and 0s;
 Easier to write... (if relevant to example)

Other valid examples accepted. Good reason with wrong example not accepted.
R saves space!

1
[7]

M6.

$1024/2^{10}$

[1]

M7.

- (a) $1024 / 2^{10}$;
 A 10000000000₂ (10 0's)

1

- (b) (i) 1111111111111111; (16 1's)
 A FFFF;
 A 65,535 / $2^{16} - 1$;

1

- (ii) 0000 0000 0010 0101; *accept if leading zeros not given*

1

- (c) (i) 0011 0011 1011 0111;;; *accept 37 transposed: 1011 0111 0011 0011;;;*

1 mark for parity bits - one mark for each correct character code

f.t. for parity bits: if even number of 1's in each byte ;

3

- (ii) Parity bit is set when character first generated;
 (Parity bit is adjusted to make) number of 1's / on-bits even;
 Parity bit is regenerated / the number of 1's is checked by receiver;
 If parity bit does not match / if there are an odd number of 1's an error has occurred;

2

[8]

M8.

(a) (Sound/voice) recording/er // sampling/er (software) // audio capture software;
Operating system A OS;
Driver;
Codec;
R Microphone software
R Analogue to digital converter

Max 2

(b) (i) Number of samples/measurements taken per second/unit time;
Frequency/how often samples are recorded/taken;
R Rate of ..."
R "Intervals at which ..."

Max 1

(ii) 1000 samples/measurements per second;
1 sample/measurement per millisecond (ms);
1000 Hz /1 KHz;
R 1000 (only)

Max 1

(c) 8 (bits);

1

(d) (i) (Sound) quality will be improved/clearer R Smoother // better/higher
resolution //more accurate // higher fidelity;
the height of the wave will be measured more precisely/accurately;
R larger range of frequencies is possible

Max 1

(ii) The size of the sound file will increase // file uses more memory /disk space;
R 'uses more space'

1

(e) 0110 1100;

1

(f) *All correct answers must fit the context of how the byte(s) are interpreted by the application program (not by the user of the application).*

Program instruction(s) // machine code;
Integer (number);
Real (number) / Floating point;
Exponent;
Mantissa;
(BUT Real/Floating Point + Exponent + Mantissa scores Max 2)
BCD (number);
R Number / denary / binary

ASCII (code);
Unicode;
EBCDIC;
Character (BUT not in addition to specific codes above) **R** Keystroke;

Address / pointer /memory reference **R** Location;
String **R** Word;
Format code // system setting / device status/signal;

A any 'data type' descriptor (e.g. Boolean) – any three data types gets
but excluding any answers above;
A Colour;

Max 3

[11]

M9.

(a) 16 (bit);
A 2 bytes

1

(b) 8,800,000 // 100 * 2 * 44,000;;;
//
100;
2; **A** 16 ÷ 8; **A** different value for the sampling resolution (16) being used in the
calculation but only if matches answer to part 15 44,000;
Max 2 if final answer incorrect

3

(c) Because of Nyquist's theorem // Because we should sample at least double the
highest frequency in the original sound;
Some people can hear higher frequencies than the average (so more than double
has been chosen);
There is no need to sample at a higher rate as humans won't notice any difference in
quality above this level // sampling at a lower rate would mean that some people
would notice the lower quality of the recording // sampling at a lower rate would
mean that some meaningful changes in the analogue signal could be missed;
higher rate would require more, unnecessary, storage space;

Max 2

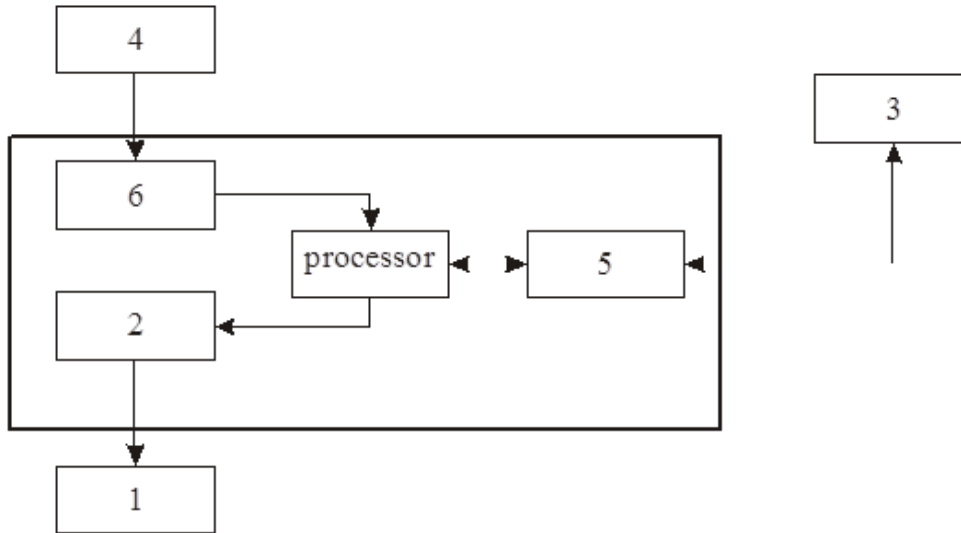
(d) Compression has been used;
A Explanation of a particular compression method that could have been used on the
recording e.g. lower sampling frequency used // lower sampling resolution used;

1

[7]

M10.

(a)



A text labelling of the diagram

6

- (b) (i) Sound which has been produced using the computer/from software;
Sound which has been digitally produced;
R 'electronically' produced
- (ii) Any plausible example where sound is not naturally produced e.g. keyboard synthesiser /computer generated voice response / mobile phone ring-tone;
R anything 'geographically'
R edited sound files

Max 1

1

[8]

M11.

- (a) Picture is broken into a grid of pixels;
A diagram; R dots R parts R screen for each pixel a number/value is stored; in memory; number/value represents a colour; R *black/white answers*

Max 2

- (b) The graphic can be enlarged/reduced/zoomed in/out without distortion;
Can take up much less (memory) space / smaller file size;
Image is more accurate; smooth edges/lines; can produce 3D images;

Max 1

[3]

M12.

- (a) 300; * 2;
//
600;;

Note: award 1 mark for doubling an incorrectly calculated highest frequency

2

(b) Regular samples are taken (of the analogue signal);
 Samples are quantised // the height of each sample is approximated to an integer value // height of samples measured // amplitude/volume measured;
 Each integer value is encoded as a binary value // measurements are coded in a fixed number of bits;
 output the binary numbers as digital signals / voltage levels;

Max 3

(c) Can (easily) synthesise musical notation from it;
 Can be played on different instruments;
 Can be (easily) transposed to a different key/pitch;
 Produces (relatively) small files;
 Easy to manipulate (the data);
 Allows for easy interface with electronic musical instruments;
 No data lost about a musical note;

Max 1

(d) Length/duration (of note) // Note-on and Note-off;
 Instrument;
 Velocity//Speed;
 Volume//Amplitude;
 Timbre;
 Pedal effects;
 Channel;
 Instructions about how to recreate a sound;
 Aftersustain;
 Pitch bend;
 Note envelope;
R Note/key/pitch/frequency;
A Other sensible answers;

Max 1

[7]

M13.

(a) The number of pixels / dots; per cm / inch / unit of measurement;

2

(b) The number of bits used to represent (the colour / greyscale value);
R number of (different) colours of a single pixel;

2

(c) $50; // 10 * 10; * 4 \div 8; // 100; \div 2; // 100; * 0.5;$

Max 1 if final answer not correct

2

(d) Does not deteriorate (**A** Concept of deteriorating by implication)
 when enlarged/magnified //
 (usually) faster to transmit //
 (usually) faster to load //
 (usually) uses less memory / storage space //
 Easier to edit/manipulate objects in the image (**A** Alternative word to object);
NE Easier to edit / manipulate

1

[7]

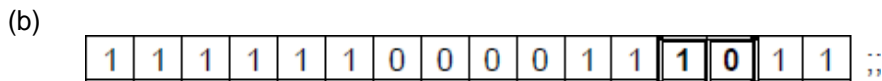
M14.

- (a) Smallest ;
picture element // unit which can be drawn on screen //
addressable / resolvable part / unit of a picture ; 2
- (b) (i) 0010 1010 ; 1
- (ii) 184 ; 1
- (c) (i) pixels are stored as numbers // bit patterns / binary code // RGB bits ; 1
- (ii) 8 ; **A** 1 byte 1
- (d) (i) drawing is made up of drawing objects // or by example e.g. drawing is made up of circle / rectangle / straight line / etc. (must give at least two example objects) ;
different objects(**A** shapes) have a defined set of properties // or by example;
objects are stored as drawing commands / drawing list ;
some properties use mathematical equations / formulae ; Max 2
- (ii) object type ; co-ordinates / location of the centre **R** centre (only) ; radius / diameter ; fill colour ; fill style ; line thickness ; line colour ; line style ; anything reasonable ;
R colour (only) Position (only) Max 3

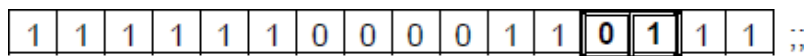
[11]

M15.

- (a) (Each pixel) can be one of $4/2^2$ possible colours/values // Two bits are needed to represent the 4 possible bit patterns / colours / values // because there are 4/more than 2 colours in the image 1



//



Mark as follows:

13th and 14th bits correct;
Other bits correct

2

- (c) $8 \times 8 = 64$; $8 \times 2 = 128$; $128 \div 8 = 16$; //
 $8 \times 8 \times 2 \div 8$;;;
 16;;;
A 128 bits as being worth 2 marks

3

- (d) (Type of) shape // rectangle // square;
 Coordinates of corner/corners // position of a corner // top left coordinates;
 Identifier;
 Length of side(s) // width // height // coordinates of an opposing corner;
 Line colour // outer colour;
 Line width;
 Fill colour // inner colour;
 Angle of rotation;
A coordinates of midpoint/centre;
A radius/diameter
A circle/oval
NE Position/coordinates
NE Colour

Max 3

- (d) (For geometric images) less storage space / memory likely to be needed;
NE less space
 (For geometric images) will load faster from secondary storage;
 (For geometric images) will download faster;
 Can be scaled / resized without distortion;
A zoom
 Image can be (more easily) searched for particular objects;
 Can (more easily) manipulate individual objects in an image;

Max 2

[11]

M16.

(a)

Comp	S/ware	Hardware	Hardware and software
Wireless router			TICK;
Compiler	TICK;		
Keyboard		TICK;	A TICK;

A crosses used rather than ticks

R answers where two columns have been ticked in a single row

3

- (b) (i) Provide an interface between the computer and user;
 To manage devices / files / memory;
 To provide a virtual machine;
 To provide a software platform on which other programs can run // to run application software;
 To hide the complexity of the hardware from the user;
NE to allow user to use hardware
R to execute commands

Max 1

- (ii) To allow sharing of run-time code across programs;
To save memory as routines are only loaded when needed;
To provide access to procedures / functions when writing a program;,
To reduce amount of programming required // time taken to write program;
Max 1
- (c) (i) Meets all of the end-user requirements;
Only performs necessary functions;
Can be fitted into existing hardware / software;
Max 1
- (ii) More expensive as have to cover production costs;
Not available immediately // have to wait for software to be written;
Less widely tested so more likely to contain bugs;
Lack of 3rd party support;
NE (more) expensive
R “no testing”
Max 1

[7]

M17.

Processor management // Allocation of processors // Allocation of processor time // (process) scheduling // thread management;
A processing management
 Allocation/management of RAM / memory // allocation of buffers;
 Allocation/management of / control of I/O devices/peripherals // I/O management // device driver management;
 File / backing store / secondary store management / access / organisation;
 Power / battery management;
A Interrupt handling;
A Provision of Application Program Interface / API;
A interface between hardware and applications;
A Provision / management of (windows in) user interface;
A Management of system security;
A Answers by example, only one example of each type
A A description of a type of software management but not just “software management”.
 e.g. loading of programs, software installation, registering DLLs.
R Software management alone unless role of OS in this is clear e.g. installation of new software, updating registry

Max 3

[3]

M18.

NO PRODUCT NAMES

- (a) (i) Physical/electrical/electronic components/parts/devices/circuits (of the computer);
R things you can touch **R** actual components **R** examples (questions asks for meaning of)
R physical machinery connected to computer (*t.o.*)
Max 1
- (ii) Programs (which run on the computer/hardware); sequences of instructions /codes;
Max 1

- (b) (i) **R** what runs on computer
 layer of software which enables users to operate computer; interface between user and computer software which allows user to communicate with / manage hardware; software to run applications/hardware/programs/computer/packages; software to make computer/hardware work / used to maintain hardware;
A operating system;
R platform
R software used to run the system / it

Max 1

- (ii) Operating system (*if not given in (i)*); utility programs / library programs / compilers/ assembler / interpreter / file manager / bootstrap loader / hardware driver / BIOS / spooler / communication software / device manager / memory management / GUI / screen saver; **R** kernel *or an example of a utility program*; eg defragmenter; compression software; text editor; virus checker;
 NO PRODUCT NAMES: **R** winzip / notepad etc

Max 1

- (iii) Application Software; bespoke software;
A generic software;
R generic system **R** dedicated package **R** utility program
R general purpose software
R off the shelf software **R** any type of system software word processor / spreadsheet / DTP / Game /image processing software;
A browser *any suitable bespoke example e.g. payroll*;
R integrated package

No link between (iii) and (iv) i.e. no follow through

[6]

M19.

- (a) To hide the complexities of the hardware from the user // Provision of virtual machine;
R Provision of user interface **NE**
A machine for hardware but **R** system, computer
 Manages the hardware (resources) // allocation of hardware resources (to processes);
A Examples of resources

2

- (b) Subject-related points:

Desktop computer used for many different/generic purposes; so ...

- desktop OS must support a wide range of peripherals/storage devices;
- desktop OS must run wide range of software/packages;
- desktop OS more customisable (by user);
- desktop OS must manage security;

Desktop computer requirements more likely to change over time // more likely to want to add new features/support new applications; so....

- desktop OS has modular design / easier to upgrade;

Desktop computers made by many different manufacturers // to varying specifications; so....

- desktop OS must run on wider range of hardware platforms;

Desktop computer more likely to be networked; so...

- desktop OS must support networking protocols;

Embedded systems (often) made at low cost // may have minimal processing requirement; so...

- embedded system OS has lower hardware requirements (allow e.g. such as slower processor, less RAM);

Embedded systems have few inputs and outputs to user; so...

- embedded system OS provides no/minimal user interface;
- embedded system OS designed to deal with input from sensors // output to control devices;

Embedded systems (often) in battery powered devices; so

- managing power consumption particularly important; **A** example of power management

Embedded systems (are sometimes) real-time // for safety-critical applications; so...

- real-time embedded system OS must be designed to guarantee speed of response // respond very quickly;*
- real-time embedded system OS must deal with many inputs simultaneously;*
- real-time embedded system OS may need to be failsafe;*
- real-time embedded system OS may incorporate redundancy;*

* - These points only valid if real-time system specifically referenced.

A any mix of points. The reason does not have to be stated to award a mark for the difference/feature.

A converse of the points if the point itself has not been given.

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of written communication criteria (QWCx).

SUB	Candidate has made three or more relevant points.
QWC1	Text is legible
QWC2	There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
QWC3	The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
QWC4	Sentences and paragraphs follow on from one another clearly and coherently.
QWC5	Appropriate specialist vocabulary has been used.

3-4

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of written communication criteria (QWCx).

SUB	Candidate has made two relevant points.
QWC1	Text is legible
QWC2	There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.
QWC3	The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.
QWC4	The candidate has used well-linked sentences and paragraphs.
QWC5	Appropriate specialist vocabulary has been used.

2

To achieve a mark in this band, candidates must meet the subject criterion (SUB).
The quality of written communication should be typified by the QWCx statements.

- SUB Candidate has made just one relevant point.
- QWC1 Most of the text is legible.
- QWC2 There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.
- QWC3 The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.
- QWC4 Sentences and paragraphs may not always be well-connected or bullet points may have been used.
- QWC5 Specialist vocabulary has been used inappropriately or not at all.

1

Candidate has made no relevant points.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of written communication criteria then drop mark by one band, providing that at least 3 of the quality of written communication criteria are met in the lower band. If 3 criteria are not met then drop by two bands.

4

[6]

M20.

- (a) Text / scene / code / object editor;
A Word processor
A form/screen for text/code entry/input/write

1

- (b) Translates (A converts/changes) program code/source program; from high level language; into machine code/object code;
R binary
Checks the program code/statements for errors;
If no errors found the executable file is generated;
T/O –1 Mark if the explanation includes 'executing the machine code'

Max 2

error report/list; A error message(s) R error (only)
an intermediate (object) file;
A a copy of the source code;

1

- (c) Interpreter software translates/checks/reads the program code one statement at a time (A line by line);
Checks the statement for the correct syntax;
If no errors found, interpreter recognises the statement;
Interpreter calls a procedure to execute the statement;
A if no error found, that statement is executed;
If an error is found, program execution is halted (and the error reported);
The program runs until an error is found;

Max 2

- (d) (i) Interpreter should allow for faster program development / faster error correction / errors easier to identify ;
A easier to debug
- 1
- (ii) Compiler/source code will not be needed in order to distribute the final executable code / the exe code (alone) can be distributed to others;
the exe code (A the program) will execute (run) faster;
the exe code/ the program cannot be changed (by others);
- Max 1

[8]

M21.

- (a) OS hides complexities of hardware from the user;
- 1
- (b) Any three @ 1 each
Processor(s)/cpu(s);
Memory/IAS/Main memory;
Disk (space)/backing store; A Hard disk/drive //Floppy disk (drive)//
Secondary storage
I/O devices//peripherals; R examples
File space;
A files
R data
R programs
- Max 3

[4]

M22.

General:

Idea of 'quicker to write ' or 'easier to write ' [ONE MARK]

EXAMPLES:

Assembly language is quicker to write than machine code //

HLL is quicker to write (compared to assembly code) //

Assembly language is easier to write than machine code // HLL is easier to write (compared to assembly);

[or opposites – slower to write / harder to write]

Idea of 'understanding' [ONE MARK]

EXAMPLES:

Assembly code easier to understand than machine code //

HLL easier to understand than assembly code;

Idea of 'debugging' [ONE MARK]

EXAMPLES:

Assembly code easier to debug than machine code // HLL easier to debug (than assembly code);

Assembly language:

Solution expressed in terms of mnemonics;
 An example of a full instruction (operand and opcode)
 Easier to make mistakes in assembly language;
 Instruction composed of op-code and operand;
 Solution translated by using an assembler;
 Code is hard to port to other types of computer // machine-oriented languages;
 One assembly language instruction relates to one machine code instruction;
Situation – working on embedded hardware // need for small object code size //
 need for fast execution // need to access hardware / registers directly;

Imperative language:

Imperative is where the programmer gives the computer a sequence of instructions to perform; Selection / Sequence / Iteration constructs available;
 A full example of a selection / iteration construct
 Library of pre-written functions available;
 Solution translated by using a compiler / interpreter;
 A compiler might not be available for a specific processor (disadvantage);
Situation – anything sensible that would need a HLL (for example games programming)

Declarative language:

(Certain languages) define what is to be computed rather than how the computation is to be done;
 (Certain languages) lack side effects;
 (Certain languages) have a clear link to mathematical logic;
 (Certain languages) express solutions in terms of facts and rules // rule-based;
 (Certain languages) will use an inference engine to work out the answer;
 The user asks a question of the system rather than provide an algorithm of the solution;
 Uses back-chaining / backtracking;
 (Certain languages) express solutions using markup languages (such as HTML);
 (Certain languages) express solutions as CSS / regular expressions / (subset of) SQL;
 A example code from part of a declarative program (ie an SQL statement)
Situation – medical diagnosis // expert systems // database query // creating a web page / website;

Imperative and Declarative language:

Solution expressed in terms of statements written using English-like keywords;
 Code easier than assembly language to port to other types of computer;
 One language statement maps to many (more than one) machine code instruction;

Note: accept any sensible situation for each area

Mark Bands and Description

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all 5 of the quality of language criteria(QWCx).

- SUB** Candidate has covered all three language generations and made at least 7 subject-related points.
- QWC1** Text is legible.
- QWC2** There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
- QWC3** The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently
- QWC4** Sentences (and paragraphs) follow on from one another clearly and coherently.
- QWC5** Appropriate specialist vocabulary has been used.

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

SUB Candidate has covered at least 2 of the 3 generations and has made at least 3 subject-related points.

QWC1 Text is legible.

QWC2 There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.

QWC3 The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.

QWC4 The candidate has used well-linked sentences (and paragraphs).

QWC5 Appropriate specialist vocabulary has been used.

3-6

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

SUB Candidate may not have covered all generations, but has covered at least one of them. At least one valid point has been made.

QWC1 Most of the text is legible.

QWC2 There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.

QWC3 The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.

QWC4 Sentences (and paragraphs) may not always be well-connected.

QWC5 Specialist vocabulary has been used inappropriately or not at all.

1-2

Candidate has made no relevant points.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of written communication criteria then drop mark by one band, providing that at least 4 of the quality of language criteria are met in the lower band.

If 4 criteria are not met then drop by two bands.

Max 8

[8]

M23.

- (a) Third (generation) // 3;
R High Level Language

Do not reject high level language if answer also contains '3rd generation' – refer upwards for anything else.

1

- (b) (i) Hexadecimal // base 16;
A Hex

Hex used in textbook

1

- (ii) Take up less space when printing / viewing;
NE takes up less space
Less likely to make errors;
Op-codes are easier to recognize;
Easier to understand;
Less time taken when coding as more concise // quicker to program;
NE easier to read
NE quick to write

Max 1

- (iii) Lowest address : 00
Highest address : FF

BOTH correct to gain one mark;

A 0 for lowest address
A 255 for highest address
A notation in front of hex &, \$

1

- (c) When coding for execution speed;
When coding to minimize object code size;
When writing code to control devices / directly access hardware;
A When coding for a specific processor;
A by example if maps to one of the above

Max 1

- (d) A compiler produces object code/machine code;
whilst an interpreter does not produce any object code;
Interpreted code will execute slower;
than executing the object code produced by a compiler;
You always need the interpreter to interpret source code;
but you do not need the compiler to execute a compiled program;
Once compiled source code is no longer required to run the program;
An interpreter always needs source code at runtime;
Compiled code can only be executed on a machine with the same processor type /
instruction set;
Interpreted code is more portable;
A compiler translates the whole source code (at once);
An interpreter analyses the code line by line;
NE reads

Max 4

[9]

M24.

- (a) Very hard/difficult to understand;
Very easy to make mistakes;
Hard to find any errors/mistakes in the code;
Time consuming to develop software in assembly language;
Lack of portability;
Lack of in-built functions/procedures;
NE harder to learn

Max 2

- (b) Compiler produces object code to distribute that is difficult to reverse engineer/ no need to distribute the source code;
 Compiler optimises the code // The object code /program runs faster (as it does not need translating);
NE "Runs faster", if not clear whether this applies to the program or the compiler.
 The target computer has no need to have the original compiler;
 Object code can be installed on target computer;
 No interpreter available for target machine;

2

[4]

M25.

- (a) (i) Assembler;

1

- (ii) Interpreter / compiler;

Max 1

- (b) Problem oriented;
 Portable; machine independent;
 One-to-many mapping of HLL statement to machine code statement;
 Datatypes; structured statements; local variables; parameters; data structures;
A example of a datastructure;
 Named variables; named constants; English-like keywords/commands;
 Quick/easy to understand / write / debug / learn / maintain;
R quick/ easy to use
R modular
R procedures
R takes longer to translate
R closer to English

Max 2

- (c) Easier to understand / more transparent; less error prone; easier to maintain / change (if the value changes);

Allow by example

eg if VAT rate changes only need to change value in declaration

Max 1

- (d) (i) Accept any imperative HLL such as Pascal/VB/C/C++/PL1/Cobol;

SEE TABLE FOR DIFFERENT LANGUAGE EXAMPLES FOR (ii) & (iii)
Ignore line breaks in statements

1

- (ii) *1 mark for correct key words in correct order (shown in bold in table overleaf);*
1 mark for correct Boolean expression / loop control expression ;

2

- (iii) *1 mark for correct key words in correct order (shown in bold in table overleaf);*
1 mark for correct boolean expression;

2

If (i) does not match (ii) and (iii) do not give marks for (ii) and (iii)
 If candidate names a language you are not familiar with, contact your team leader

Language	Bool expr	Iteration <i>....are possible statements(ignore)</i>	Selection <i>....are possible statements(ignore)</i>
Pascal Delphi Kylix	a>b a=b a< >b a<b a>=b a<=b	FOR <variable>:= <value1> TO <value2> DO REPEAT UNTIL <bool expr> WHILE <bool expr> DO	IF <bool expr> THEN <i>else part optional</i> CASE <variable> OF <value1>..... <value2>..... ENDCASE <i>else part optional.</i> <i>No of values can vary</i>
Visual Basic VSScript	a>b a=b a< >b a<b a>=b a<=b	FOR <variable> = <value 1> TO <value2> NEXT DO WHILE/UNTIL <bool expr>LOOP DO LOOP UNTIL/WHILE <bool expr> WHILE <bool expr> WEND	IF <bool expr> THEN END IF <i>Else part optional</i> SELECT CASE <variable> CASE <value1> CASE <value2> End Selct <i>Else part optional</i> <i>No of CASE values can vary</i>
C/C++ Java Javascript	a>b a==b a!=b a<b a>=b a<=b	FOR (<initialisation>; <condition>; <increment>)..... WHILE (bool expr) DO	IF (bool expr) { } <i>Else part optional</i> SWITCH () {CASE <value>: BREAK} <i>No of CASE values can vary</i>
COBOL	a>b a=b a< >b a<b a>=b a<=b	PERFORM<number> TIMES PERFORM VARYING <variable> FROM <value>BY <value> UNTIL <bool expr using variable>	IF <bool expr> PERFORM <i>Else part optional</i>
Fortran	a.LT.b a.GE.b a.LE.b a.GT.b a.NE.b a.EQ.b	DO <number> < variable>= <init value> <final value> <i>step value optional</i>	IF <bool expr> IF (<arithmetic expr>) label1, label2, label3
Basic	a>b a=b a< >b a<b a>=b a<=b	FOR <variable> = <start value> TO <stop value> NEXT <variable> <i>step value optional</i> REPEAT UNTIL <bool expr>	IF <bool expr> THEN GOTO label1, label2, label3 DEPENDING ON <variable>

2

[10]

M26.

(a) OR gate

Input A	Input B	Output
0	0	0
0	1	1
1	0	1
1	1	1

NAND gate

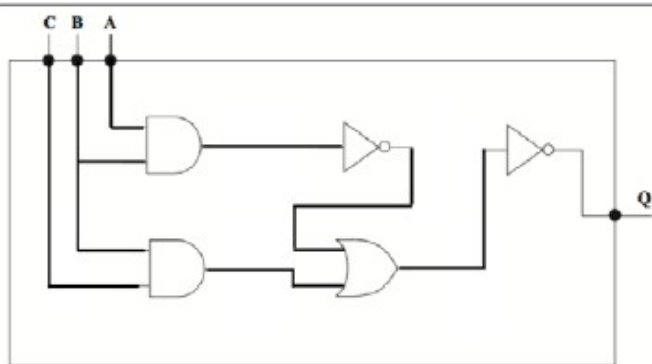
Input A	Input B	Output
0	0	1
0	1	1
1	0	1
1	1	0

1 mark for correct output OR gate;

1 mark for correct output NAND gate;

2

(b)



1 mark for inputs A and B connected to AND gate;

1 mark for inputs B and C connected to AND gate;

1 mark for output of AND (A,B input) as only connection going to NOT gate;

1 mark for output of NOT gate plus the AND gate (B,C input) going to OR gate;

1 mark OR gate as only connection going to NOT gate and output only connection to Q;

5

(c) **MAX 2 if working out is not logically sound**

Example 1:

$$\overline{\overline{A + B}} + B \cdot \overline{A}$$

$$A \cdot B + B \cdot \overline{A}$$

Having applied De Morgan's correctly;

$$B \cdot (A + \overline{A})$$

Having factorised;

Final answer: **B** ;

Example 2:

$$\overline{\overline{A + B}} + B \cdot \overline{A}$$

$$\overline{(\overline{A + B}) \cdot (\overline{B + A})}$$

Having applied De Morgan's correctly;

$$\overline{\overline{A} \cdot \overline{B} + \overline{A} \cdot A + \overline{B} \cdot \overline{B} + \overline{B} \cdot A}$$

Expanded bracket;

$$\overline{\overline{A} \cdot \overline{B} + 0 + \overline{B} + \overline{B} \cdot A}$$

Simplified elements

$$\overline{\overline{B}}$$

Having used $C + C \cdot D = C$ to simplify

$$\overline{\overline{B}}$$

Having used $C + C \cdot D = C$ to simplify again

Final answer: B ;

Truth Table Answer

A	B	$\overline{\overline{A + B}}$	$B \cdot \overline{A}$	$\overline{\overline{A + B}} + B \cdot \overline{A}$
0	0	0	0	0
0	1	0	1	1
1	0	0	0	0
1	1	1	0	1
		X	Y	Z

1 mark for both columns marked X and Y above; (column X could be labelled **A.B**)

1 mark for final column Z;

1 mark for final answer: B;

M27.

(a)

AND Gate		
Input X	Input X	Output Q
0	0	0
0	1	0
1	0	0
1	1	1

XOR Gate		
Input X	Input X	Output Q
0	0	0
0	1	1
1	0	1
1	1	0

1 mark for each of the output columns

2

(b) (i) $(L \oplus R) \cdot \bar{U}$

[Brackets are not necessary]

1 mark for use of correct operands (L,R,U);
1 mark for use of XOR with L,R;
1 mark for NOT U anded with other part;

alternative: $(L + R) \cdot (\bar{L} \cdot \bar{R}) \cdot \bar{U}$

1 mark for use of correct operands (L,R,U);
1 mark for alternative XOR expression;
1 mark for AND NOT U;

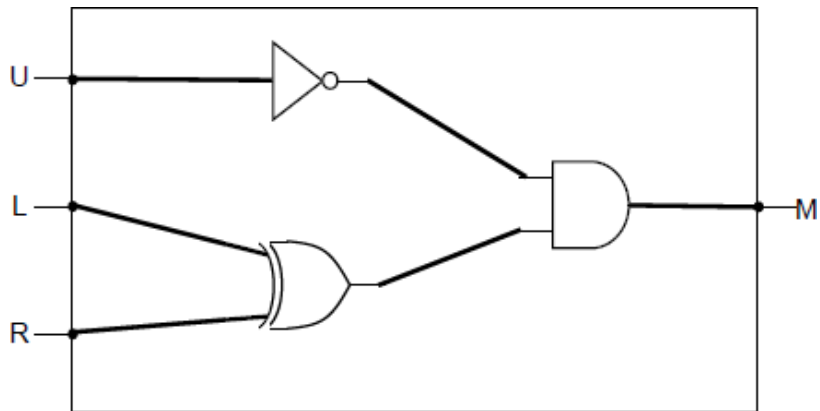
alternative: $(L \cdot \bar{R} + \bar{L} \cdot R) \cdot \bar{U}$

1 mark for use of correct operands (L,R,U);
1 mark for alternative XOR expression;
1 mark for AND NOT U;

Acceptable notation for symbols
~ for NOT
X.Y allow X AND Y, $X \text{ } \exists \text{ } Y$, $X(X)Y$, XY
 $X+Y$ allow X OR Y, $X(Y)$, $X*Y$

3

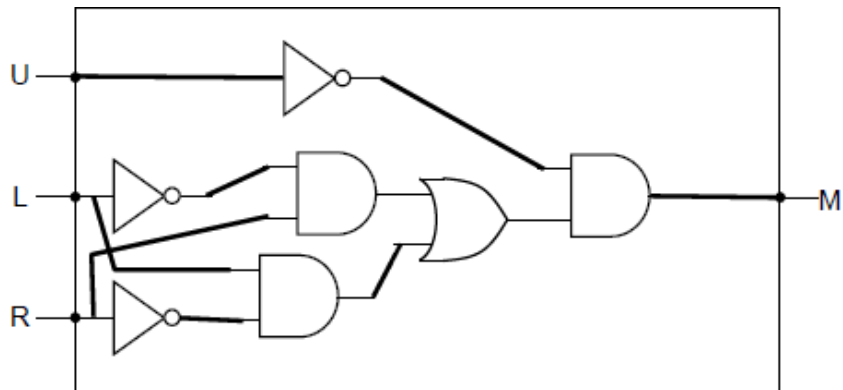
(ii)



L, R connected to XOR gate;
U connected to NOT gate;
Output of a two input AND gate connected to M;

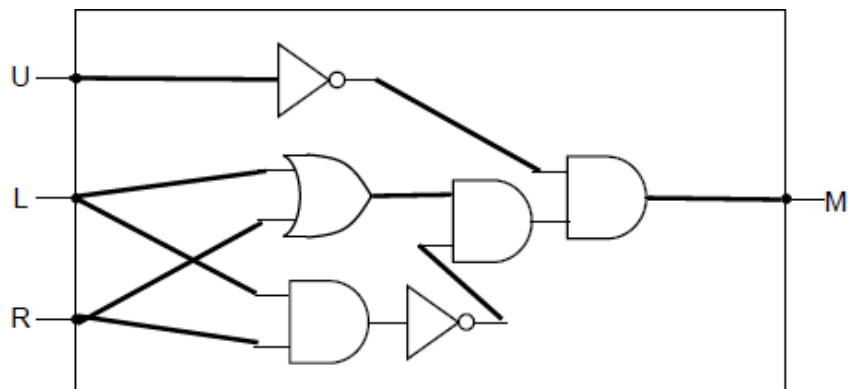
Max 2 if circuit does not reflect the correct logic

Alternative :



U connected to NOT gate;
Correct gates used for L and R before last AND gate;
Output of a two input AND gate connected to M;

Alternative :



Marked as above alternative.

(c) **Solution 1:**

$$Q = \overline{\overline{A} (\overline{B.A})} \quad [\text{Application of De Morgan's Law -1 mark}]$$
$$Q = \overline{A.B.A} \quad [\text{allow simplification of double nots at same time}]$$
$$Q = \overline{A.A} \quad [\text{Simplification of A.A to A -1 mark}]$$
$$Q = \overline{A.B} \quad [\text{Correct solution - 1 mark}]$$

Solution 2:

$$Q = \overline{\overline{A} + (\overline{\overline{B} + \overline{A}})} \quad [\text{Application of De Morgan's Law -1 mark}]$$
$$Q = \overline{\overline{A} + \overline{\overline{B} + \overline{A}}} \quad [\text{allow simplification of double nots at same time}]$$
$$Q = \overline{\overline{A} + \overline{B}} \quad [\text{Simplification of NOT A OR NOT A to NOT A - 1 mark}]$$
$$Q = \overline{A.B} \quad [\text{De Morgan's again to correct solution - 1 mark}]$$

1 mark for De Morgan;
1 mark for simplification;
1 mark for final answer;
Other notations as for section (b)

No working marks for truth table solution (asked to use De Morgan's in question)

3

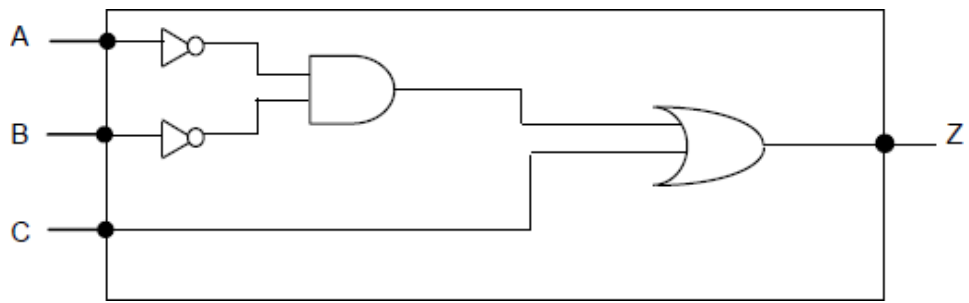
[11]

M28.

(a)	NAND	NOR
	1	1
	1	0
	1	0
	0;	0;

2

(b)



1 mark for NOT gates on both A and B;
1 mark for AND with inputs from \bar{A} and \bar{B} ;
1 mark for OR gate with inputs from AND gate output and C and output connected to Z;

3

(c) $(\overline{A \cdot B}) + (\overline{A \cdot \overline{B}})$

$(\overline{A+B}) + (\overline{A+B})$; ; 2 marks – 1 each for De Morgans rule for each side of the central OR (award the mark for right hand expression, even if double NOT over B is not cancelled)

$\overline{A+B} + B$ Recognising NOT A OR NOT A is NOT A, and producing a correct expression

$\overline{A} + 1$; Recognising B or NOT B is 1

Final answer 1 ;

Alternative answer

$\overline{\overline{A \cdot B} \cdot \overline{A \cdot \overline{B}}}$; Application of De Morgan's to entire expression

$\overline{A \cdot B} \cdot \overline{A \cdot \overline{B}}$; Cancellation of NOTs; 1 mark – De Morgans on entire expression

$\overline{A \cdot B \cdot B}$ Recognising A and A is A

$\overline{A \cdot 0}$ Recognising B ANDed with its complement is 0

$\overline{0}$; Recognising 0 AND anything is 0

Final answer 1 ;

Note: Marks can be awarded for the skills above if seen but Max 3 (out of 4) for whole question if working has errors in it

A T, True for 1 and F, False for 0

A alternative notations :

- For X.Y allow X AND Y, $X \wedge Y, X \cap Y, XY$
- For $X+Y$ allow X OR Y, $X \vee Y, X \cup Y$
- For \overline{X} allow NOT X, $\neg X$

Or by truth table M = marking point

A	B	$A \cdot B$	$\overline{A \cdot B}$	\overline{B}	$A \cdot \overline{B}$	$\overline{A \cdot \overline{B}}$	$\overline{A \cdot B} + \overline{A \cdot \overline{B}}$	M
0	0	0	1	1	0	1	1	1
0	1	0	1	0	0	1	1	1
1	0	0	1	1	1	0	1	1
1	1	1	0	0	0	1	1	1

Max 3 for stages, 1 for final answer

M29.

- (a) increase the number of bits that can be transferred at one time ;
A increase rate of data transfer;

increases the number of (memory) addresses / addressable locations //
 increase the maximum amount of primary store / memory (possible);

instructions performed more quickly // instructions executed at faster rate //
 fetch execute cycle will happen faster //
 increased heat may cause malfunctioning of device // overheating;

A calculations / operations / commands for instructions

3

- (b) (i) a (hardware) device / component that is not part of the CPU;
NE processor / computer
 a (hardware) device not directly under the control of the processor / CPU;
 a device that communicates through an I / O controller;
 external hardware / device;
R examples alone

MAX 1

- (ii) to allow exchange of data / instructions / signals between the processor and
 the peripheral;
A communicate
R information
NE To allow the device to be connected

1

- (iii) Electronics that interface the controller to the system bus;
 Electronics appropriate for sending signals to the device connected to the
 computer;

MAX 1

- (iv) Each peripheral operates in a different way;
 Not sensible to design a processor to control every possible peripheral;
 A new type of peripheral would require the processor to be redesigned;
 Peripherals may operate at a different voltage from the processor;
 Peripherals will usually operate at a slower rate than the processor (requiring
 buffering);

MAX 2

[8]

M30.

(a)

Number	Component Name
1	Memory Address Register
2	Address Bus
3	Memory Data / Buffer Register
4	Data Bus

4

(b) The instruction is held in the CIR;
A IR
 The control unit / instruction decoder decodes the instruction;
 The opcode identifies the type of instruction it is;
 Relevant part of CPU / processor executes instruction;
A ALU
 Further memory fetches / saves carried out if required;
 Result of computation stored in accumulator / register / written to main memory;
 Status register updated;
 If jump / branch instruction, PC is updated;
A SCR
Max 3

(c) Can be displayed in less space;
R takes up less space **NE**
 Easier to remember / learn / read / understand;
 Less error prone;
Max 1

(d) (i) Assembler;
1

(ii) HLLs are problem oriented;
 HLL programs are portable // machine / platform independent ;
 English like **keywords / commands/ syntax / code**;
R closer to English
 Less code required // less tedious to program //
 one to many mapping of HLL statements to machine code commands;
 Quicker/easier to understand / write / debug /learn / maintain code;
R just quicker/easier
 HLLs offer extra features e.g. data types / structures // structured statements //
 local variables // parameters // named variables/constants;
R procedures / modular
A example of a data structure
NE “extra features” without example
 Speed of execution not crucial for most tasks so faster execution of assembly
 language not required;
 Most computer systems have a lot of (main) memory / RAM so compact object
 code not essential;
A converse points for Assembly Language
3
[12]

M31.

(a) Program Counter;
A Sequence Control Register
R Next Instruction
 Register
 Current Instruction Register;
A Instruction Register
 Memory Buffer Register;
A Memory Data Register
 Memory Address Register;
Max 2

- (b) Address in MAR/address to fetch instruction from, sent down Address Bus to Main Memory;
R address in PC (program counter)
 Contents of address accessed in Main Memory;
A by implication if contents of address location referred to during data transfer
 Contents of address location//instruction//data passed down Data Bus into MBR/to processor;
A MDR instead of MBR
A RAM for Main Memory

Max 2

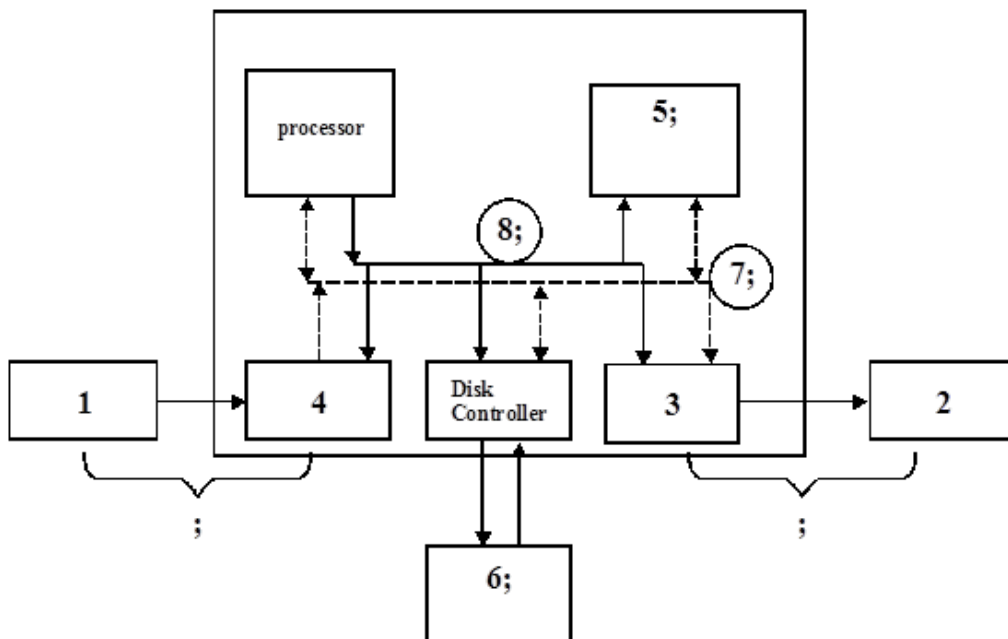
- (c) Order of execution unimportant/one step does not rely on prior completion of the other;
 Steps carried out by different (hardware) devices/components;
A operations are independent
A operations use different registers
R using different buses

Max 1

[5]

M32.

(a)



Allow names instead of numbers

6

- (b) Machine code instructions/program stored in main memory; **A** RAM/IAS;
 Fetched and executed; (*concept*)
 Can be replaced by another program any time;
R cache
R ROM

2

[8]

M33.

- (a) (memory) address / location;
R Line number 1

- (b) second (generation) //assembly language/code/program //
2 / 2nd; 1

- (c) (i) assembler;
R. assembly 1

- (ii) error list / error report / error count / **A** error message / highlight statement(s)
illegally formed / instruction count // symbol table;
R error 1

- (d) program (instructions are) transferred from backing store to main memory;
program consists of a sequence of instructions;
stored in a (continuous area of) main memory;
an instruction is fetched (and decoded);
and then instruction executed (by the processor);
program can be replaced by another program at any time;
program instructions are treated as data; Max 4

[8]

M34.

- (a) Keyboard // keypad // concept keyboard // numberpad;
Touch-screen;
R mouse 2

- (b) A light source / laser is shone at bar code // a bar code is illuminated; **NE** beam / photons

(moving) mirror / prism moves light beam across bar code // user moves reader across bar code // user moves the bar code across the reader;
NE beam

Light reflected back;

Black / white bands reflect different amounts of light // black reflects less light // white reflects more light;

Light sensor / photodiode / CCD (measures amount of reflected light);

Light reflected converted into an electrical signal;
A convert reflection to (binary) numbers / characters / ASCII

Check Digit:

The (12) data digits are passed through a function to calculate a check digit;

The result is compared against the check digit read in // check digit compared to rest of bar code;

If they do not match an error is indicated;

If they match the bar code is accepted and processed;

Mark Bands and Description

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all 5 of the quality of language criteria (QWCx).

<i>SUB</i>	Candidate has made at least five subject-related points. Candidate has made valid points about both scanning and the check digit in their answer.
<i>QWC1</i>	Text is legible.
<i>QWC2</i>	There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
<i>QWC3</i>	The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
<i>QWC4</i>	Sentences (and paragraphs) follow on from one another clearly and coherently.
<i>QWC5</i>	Appropriate specialist vocabulary has been used.

5-6

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

<i>SUB</i>	Candidate has made at least three subject-related points.
<i>QWC1</i>	Text is legible.
<i>QWC2</i>	There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.
<i>QWC3</i>	The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.
<i>QWC4</i>	The candidate has used well-linked sentences (and paragraphs).
<i>QWC5</i>	Appropriate specialist vocabulary has been used.

3-4

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

- SUB* Candidate has made at least one subject-related point.
- QWC1* Most of the text is legible.
- QWC2* There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.
- QWC3* The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.
- QWC4* Sentences (and paragraphs) may not always be well-connected.
- QWC5* Specialist vocabulary has been used inappropriately or not at all.

1-2

Candidate has made no relevant points.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of language criteria then drop mark by one band, providing that at least 4 of the quality of language criteria are met in the lower band. If 4 criteria are not met then drop by two bands.

MAX 6

[8]

M35.

- (a) Keyboard // keypad // concept keyboard // numberpad;
Touch-screen;
R mouse

2

- (b) A light source / laser is shone at bar code // a bar code is illuminated; **NE** beam / photons

(moving) mirror / prism moves light beam across bar code // user moves reader across bar code // user moves the bar code across the reader;
NE beam

Light reflected back;

Black / white bands reflect different amounts of light // black reflects less light // white reflects more light;

Light sensor / photodiode / CCD (measures amount of reflected light);

Light reflected converted into an electrical signal;
A convert reflection to (binary) numbers / characters / ASCII

Check Digit:

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The result is compared against the check digit read in // check digit compared to rest of bar code;

If they do not match an error is indicated;

If they match the bar code is accepted and processed;

Mark Bands and Description

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all 5 of the quality of language criteria (QWCx).

- | | |
|-------------|---|
| <i>SUB</i> | Candidate has made at least five subject-related points.
Candidate has made valid points about both scanning and the check digit in their answer. |
| <i>QWC1</i> | Text is legible. |
| <i>QWC2</i> | There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear. |
| <i>QWC3</i> | The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently. |
| <i>QWC4</i> | Sentences (and paragraphs) follow on from one another clearly and coherently. |
| <i>QWC5</i> | Appropriate specialist vocabulary has been used. |

5-6

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

- | | |
|-------------|---|
| <i>SUB</i> | Candidate has made at least three subject-related points. |
| <i>QWC1</i> | Text is legible. |
| <i>QWC2</i> | There may be occasional errors of spelling, punctuation and grammar. Meaning is clear. |
| <i>QWC3</i> | The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently. |
| <i>QWC4</i> | The candidate has used well-linked sentences (and paragraphs). |
| <i>QWC5</i> | Appropriate specialist vocabulary has been used. |

3-4

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

- SUB* Candidate has made at least one subject-related point.
- QWC1* Most of the text is legible.
- QWC2* There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.
- QWC3* The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.
- QWC4* Sentences (and paragraphs) may not always be well-connected.
- QWC5* Specialist vocabulary has been used inappropriately or not at all.

1-2

Candidate has made no relevant points.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of language criteria then drop mark by one band, providing that at least 4 of the quality of language criteria are met in the lower band. If 4 criteria are not met then drop by two bands.

MAX 6

[8]

M33.

- (a) (memory) address / location;
R Line number 1

- (b) second (generation) //assembly language/code/program // 2 / 2nd;
1

- (c) (i) assembler;
R. assembly 1

- (ii) error list / error report / error count / **A** error message / highlight statement(s) illegally formed / instruction count // symbol table;
R error 1

- (d) program (instructions are) transferred from backing store to main memory;
program consists of a sequence of instructions;
stored in a (continuous area of) main memory;
an instruction is fetched (and decoded);
and then instruction executed (by the processor);
program can be replaced by another program at any time;
program instructions are treated as data;

Max 4

[8]

M34.

- (a) Keyboard // keypad // concept keyboard // numberpad;
Touch-screen;
R mouse 2

- (b) A light source / laser is shone at bar code // a bar code is illuminated; **NE** beam / photons

(moving) mirror / prism moves light beam across bar code // user moves reader across bar code // user moves the bar code across the reader;
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Light reflected back;

Black / white bands reflect different amounts of light // black reflects less light / / white reflects more light;

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Check Digit:

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The result is compared against the check digit read in // check digit compared to rest of bar code;

If they do not match an error is indicated;

If they match the bar code is accepted and processed;

Mark Bands and Description

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all 5 of the quality of language criteria (QWCx).

- SUB** Candidate has made at least five subject-related points.
Candidate has made valid points about both scanning **and the check digit** in their answer.
- QWC1** Text is legible.
- QWC2** There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
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- QWC4** Sentences (and paragraphs) follow on from one another clearly and coherently.
- QWC5** Appropriate specialist vocabulary has been used.

5-6

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

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- QWC1** Text is legible.
- QWC2** There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.
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- QWC4** The candidate has used well-linked sentences (and paragraphs).
- QWC5** Appropriate specialist vocabulary has been used.

3-4

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

- SUB** Candidate has made at least one subject-related point.

- QWC1 Most of the text is legible.
 QWC2 There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.
 QWC3 The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.
 QWC4 Sentences (and paragraphs) may not always be well-connected.
 QWC5 Specialist vocabulary has been used inappropriately or not at all.

1-2

Candidate has made no relevant points.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of language criteria then drop mark by one band, providing that at least 4 of the quality of language criteria are met in the lower band. If 4 criteria are not met then drop by two bands.

MAX 6

[8]

M35.

1. reader sends radio frequency energy / wave;
2. to the antenna of the RFID tag in the book;
3. The RFID tag is energised by the reader / this energy;
4. the transponder (in the tag) sends the data signal;
5. the reader near the exit receives the data signal;

Max 2

[2]

M36.

- (a) Secondary store is non-volatile / stores a permanent copy / keeps contents when computer turned off whereas primary store is volatile / temporary / loses contents when computer turned off;

Secondary store is not directly accessible to the processor / outside main memory whereas primary store is directly accessible to processor;

Capacity of primary store is limited by width of address bus whereas no limit on capacity of secondary store;

Data in primary store can be accessed more quickly than data in secondary store;

A Answers where converse is implied rather than stated.

R Secondary store is long-term whereas primary store is short-term.

R Secondary store has a higher capacity than primary store.

2

- (b) Magnetic (medium);
 Binary digits/bits/0s and 1s/data represented by magnetising spots on disk // changing magnetic properties of disk;
 Disk divided into tracks and sectors; **A** either tracks or sectors alone
 Drive head can move in/out // moves to track // moves radially
 Disk continually spinning;
 Disk spins at high speed // feasible example of speed;
 Data read/written as correct sector passes under read/write head; **A** drive head
 Data transferred in sectors/blocks;
 May be multiple platters; **A** surfaces
 One head per platter;
 Use of cache/buffer to speed up data transfer;
 Medium and drive/device integrated // medium in sealed enclosure;
 Head parked / not over disk when not in use;

Must use accurate terminology as this is the quality of language question

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QLx).

<i>SUB</i>	Candidate has provided a clear explanation of principles of operation, including at least 5 of the points listed above.
<i>QL1</i>	Text is legible
<i>QL2</i>	There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
<i>QL3</i>	The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
<i>QL4</i>	Sentences and paragraphs follow on from one another clearly and coherently.
<i>QL5</i>	Appropriate specialist vocabulary has been used.

5-6

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QLx)

<i>SUB</i>	Candidate has provided a limited explanation of principles of operation, including at least 3 of the points listed above.
<i>QL1</i>	Text is legible.
<i>QL2</i>	There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.
<i>QL3</i>	The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.

- QL4 The candidate has used well-linked sentences and paragraphs.
- QL5 Appropriate specialist vocabulary has been used.

3-4

To achieve a mark in this band, candidates must meet the subject criterion (SUB). The quality of language should be typified by the QLx statements.

- SUB Candidate has provided a weak explanation which covers at least 1 of the points listed above for 1 mark or 2 points to get 2 marks.
- QL1 Most of the text is legible.
- QL2 There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.
- QL3 The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.
- QL4 Sentences and paragraphs may not always be well-connected or bullet points may have been used.
- QL5 Specialist vocabulary has been used inappropriately or not at all.

1-2

Candidate has not made reference to any of the points listed above.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of language criteria then drop mark by one band, providing that at least 3 of the quality of language criteria are met in the lower band. If 3 criteria are not met then drop by two bands.

6

[8]

M37.

All marks AO2 (apply)

Level	Description	Mark Range
4	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. The	10 – 12

	response covers all four areas indicated in the guidance below and in at least three of these areas there is sufficient detail to show that the student has a good level of understanding of the technologies required. A good level of understanding would be indicated by three substantiated points being made per area. To reach the top of this mark range, a good level of understanding must be shown of all four areas.	
3	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response but the response may only cover three of the areas indicated in the guidance below, with two or three substantiated points being made per area.	7 – 9
2	A limited attempt has been made to follow a line of reasoning by covering at least two of the topic areas in the guidance below. Overall, at least four valid points must have been made which can relate to any of the topic areas in the guidance.	4 – 6
1	A few relevant points have been made but there is no evidence that a line of reasoning has been followed. The points may only relate to one or two of the four areas from the guidance or may be made in a superficial way with little substantiation.	1 – 3

Guidance – Indicative Response

1. Fridge capturing data from food

RFID well suited as completely automatic short-range wireless transmission so no user involvement

- tag does not contain a power source but is energised by reader in fridge
- this causes wireless transmission of data stored in memory on tag to reader

Alternatively, scan barcode / QR code as food put into fridge

Barcode less suitable than RFID as only identifies product not use by date and must be manually scanned

Problem of how to deal with untagged produce – possible use of voice recognition or

touch screen interface

Can identify products and potentially track use by dates, but how to work out how much of the product is left – refrigerators redesigned with load cells to weigh items automatically?

2. Networking technologies

IPv4 does not have a big enough address space for the number of devices, hence introduction of IPv6

Higher bandwidth Internet connections required for so many devices

- copper-based transmission systems replaced with fibre optic

Need for a standard (application layer) protocol for devices

Security issues with many devices connected to Internet that could be hacked

Would data be communicated to retailers directly from each device or through a server in the home?

Need to consider how to deal with interference between wireless devices, collisions etc with many more devices communicating

3. The data gathered and storage

Automatic collection of data from devices will produce vast amounts of data

This volume of data would be classified as big data

May also be classified as big data due to the velocity of data collection with so many devices

Storage could be cloud based for flexibility or close to processing cores for speed

Velocity at which data generated would make solid state storage appropriate as has fast access speeds but volume of data and lower cost per megabyte of hard disk storage may mean hard disks more likely to be used

Need to consider how long to keep data for in context of

- Storage capacity available
- Complying with relevant laws about privacy

4. Processing

Volume of data means parallel processing or distributed processing architectures required

Volume of data collected makes it unsuitable for processing by traditional relational databases

Functional programming is one approach that could be used

Functional programming appropriate as works well on parallel processing systems as programs do not specify order of execution

Would software that managed contents of the fridge be run as embedded system in fridge or in the cloud / by the retailer?

Retailers may develop a standard API to interface with devices

[12]

M38.

- (a) 1 ;
4 ;
3 ;

3

- (b) (i) Optical Character Recognition;

1

- (ii) Data that can (uniquely) identify a living person;

1

- (iii) *Linked to context: (MAX 2)*

Data could be used to track location (and activities) of a person;
Data links a person to a specific location and car at a (specific) time;
Number plates might not be recognised accurately (suggesting, incorrectly, a car was at a particular location);

General points: (MAX 1)

Concern over security of data storage // security of data might be at risk;
Selling on of data;
Data used for marketing // unwanted phone calls;

MAX 2

[7]

M39.

Exactly same operation performed over and over again by programmed robot sprayer;

Position of car bodies predetermined//car bodies in known precise positions all the time//
 Robot sprayer does not need to deviate from pre-programmed position at any time // a
 strictly controlled environment;

Actions to be performed known in advance for programmed robot sprayer;

Programmed robot sprayer requires only limited sensing of environment if any // fewer
 inputs to monitor;

Robot sprayer does limited processing;

Robot sprayer has a relatively simple program which is numerically controlled;

Car system has to continuously monitor many external variables;

Car system has to perform very complex processing;

Car system will need very powerful processors;

Car system will need a range of sensors;

Car system has to analyse/react to an input very quickly (and then adjust one or
 more of the three given outputs to alter car motion);

The environment in which the car operates is not predictable//is more complex//has
 greater uncertainty;

Car system needs to know at all times exactly where it is;

Candidate may answer by example, e.g.

Car system cannot be programmed in advance to know where all pedestrians will be
 at any one time //

Car cannot be programmed in advance to know where all other moving cars will be
 at any one time //

Car system cannot be programmed in advance to know where all stationary
 obstacles such as parked cars will be//potholes at any one time;

Note: For full marks candidate must cover both problems

Max 4

[4]

M40.

- (a) International transfers span different time zones;
 Messages may get lost otherwise;
 Transfers may be batched for transfer overnight;

Max 1

- (b) To prevent fraud;
 To prevent changes to the message going undetected;
 To prevent changes to the content of the message;
 To prevent message being understood or information gathered;
R To prevent a message being read.....

Max 1

- (c) N.B.Emphasis is on government monitoring banking transfers for something
 illegal
 To make it possible for agents of the government to learn of money transfers

made by criminals;
 To make it possible for agents of the government to learn of money transfers
 made by terrorists;
R So government can monitor messages/e-mails.

Max 1

[3]

M41.

- (a) Bits are sent along a single wire/line; bits are sent one after another;
R Bits of (the) data

Max 1

- (b) (i) Data bit;
 Parity (bit);
 Signal to start data transfer/strobe;
 Signal 'ready to receive data' / busy;
 Signal to acknowledge data transfer / Complete;
 Out of paper/ink / error;
 On-line/off-line;
 Handshaking //control signal/status signal (BUT only if not by
 example above);
 Ground;

Max 2

- (ii) Transmission over long distances;
 When a high data transfer rate is required;
A No driver is available;

Max 1

- (c) Data is transmitted intermittently (rather than as a steady stream);
 Sender and receiver are only synchronized when data is being sent // start bit
 synchronises the receiver;
R Description only of start and stop bits

1

[5]

M42.

- (a) (i) Name: Start Bit;
 Purpose: Synchronise receiver;

2

- (ii) Name: Parity Bit;

Purpose: Perform parity check// check for errors in transmission;
A Prevent errors

2

(iii) Name: Stop Bit;
 Purpose: Allow start bit to be recognised//
 Allow receiver to process received bits;
A Indicates end of data

2

(b) (i) The number of signal/voltage changes per second;
A rate at which signals are sent;
A rate at which voltage changes;

1

(ii) Number of bits per second / unit of time;
R the rate at which bits are sent (*question paraphrased*)

1

(iii) Range of frequencies a channel can handle;
A maximum line speed;
A maximum transmission speed;

1

(c) A signal can contain one or more bits;
 Bit rate can be higher than baud rate;
 Bit rate = baud rate * number of bits per signal change;;

2

[11]

M43.

(a) Cables are cheaper // uses fewer wires;
 Data does not get skewed // out of line/sync;
 Simpler/cheaper/easier to boost signals;
R Cheaper on its own (n.e)

2

(b) (i) Baud is the number of signal / pulses / voltage changes per second;
A rate at which signals / pulses are sent;

- A** rate at which voltage changes; 1
 - (ii) Number of bits per second / bits per unit of time;
 Bit rate = baud rate * number of bits per signal change;
R rate at which bits are sent 1
 - (iii) Range of frequencies that can be transmitted; 1
 - (c) Greater bandwidth allows greater bit rate; 1
- [6]**

M44.

- (a) Bus;
R line 1
- (b) Star; 1
- (c) (i) (*Advantage:*) (*Reason:*)
 Lower cost// reduced cabling//
 More flexible; easy to add/remove stations;
A advantage and reason swapped round
A cheaper
R Easier to set up 2
- (ii) (*Advantage:*) (*Reason:*)
 If one cable/wire fails it affects
 Only one computer//
 Simple to isolate faults//
 Different computers
 Can transmit at different
 speeds// system more secure//
 Network does not degrade
 when highly loaded;
R collision free unless explained
R easy to add / remove computers
R reliability
R faster
R computer/node failure
A advantage and reason swapped round

M45.

- (a) System will be storing confidential / personal data (that must be kept securely / safely);
 Centralised / improved security management // centralised login system // centralised administration // administration will be easier;
 Centralised backup;
 Harder for users to change security/sharing settings;
 Running database from a server will avoid concurrency issues // will avoid problems if two users / computers update (a record in the) database simultaneously;
A will allow simultaneous updates / access
R answers that imply that on a peer-to-peer system there would be a separate copy of the database on each workstation
 Running database from server will ensure that it is always available (as server is unlikely to be turned off) // Files would always be available (as server is unlikely to be turned off);
 Server (operating system) may allow more simultaneous connections than a workstation // (operating system software on) workstations may not allow enough simultaneous connections for ten users;
NE the database could be stored on the server

Max 2

(b) **Subject-related points:****How works:**

All / most processing done by (central) server;

A all software run on server

Keystrokes/mouse clicks / user input transmitted from workstation/terminal to server over network;

A workstations are just interfaces

Image / data needed to produce image transmitted from server to terminal over network;

Applications not installed on (thin client) workstations // all applications on server;

Operating system loaded by clients from server at boot;

Selection of hardware:

Higher bandwidth network connection required;

Network must use switch not hub;

Slower processor / reduced RAM / no HDD required in workstations;

A other examples of limited hardware requirements

A 'Dumb terminal'

Server must have multiple processors/a lot of RAM;

NE more powerful / less powerful, higher performance / lower performance, cheaper / more expensive

A the opposite of points e.g. for 'Slower processor' accept 'a thick client system would need a faster processor'.

How to award marks:

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all 5 of the quality of language criteria (QWCx).

- SUB Candidate has covered both how a thin-client system works and how this affects the choice of hardware, and has made at least four subject-related points.
- QWC1 Text is legible.
- QWC2 There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
- QWC3 The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
- QWC4 Sentences (and paragraphs) follow on from one another clearly and coherently.
- QWC5 Appropriate specialist vocabulary has been used.

4

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

- SUB Candidate has covered both how a thin-client system works and how this affects the choice of hardware, and has made at least three subject-related points.
- QWC1 Text is legible.
- QWC2 There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.
- QWC3 The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.
- QWC4 The candidate has used well-linked sentences (and paragraphs).
- QWC5 Appropriate specialist vocabulary has been used.

3

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

- SUB Candidate has covered one or both of how thin client systems work and how this affects hardware choice.
- QWC1 Most of the text is legible.
- QWC2 There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.
- QWC3 The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.

- QWC4 Sentences (and paragraphs) may not always be well- connected.
- QWC5 Specialist vocabulary has been used inappropriately or not at all.

1-2

Candidate has made no relevant points.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of language criteria then drop mark by one band, providing that at least 4 of the quality of language criteria are met in the lower band. If 4 criteria are not met then drop by two bands.

4

- (c) To connect networks using different protocols // to convert transmitted data from one protocol to another;

1

[7]

M46.

- (a) (i) 192.168.0.x where x is not 0 or 255;

1

- (ii) 192.168.2.x where x is not 0 or 255

1

- (iii) 192.168.2.y where y is not 0 or 255 and the IP address is different to the one in (ii)

1

- (b) Star;

1

- (c) Identify which other computers are on same segment // can have packets/data sent directly to them;
Identify which other computers are on a different segment // must have packets/data sent to them via the router;
R network for subnet

Max 1

255.255.255.0 / FFFFFFF00 / 1111111111111111111111111100000000;

2

- (d) Use of WEP/Wired Equivalent Privacy/WPA/WiFi Protected Access;
(Strong) encryption of transmitted data;
R encoding
User/computer must enter/send a passphrase/certificate at start of communication before laptop allowed to connect;
A key for passphrase
A only allow password if used in correct context;
Access point checks MAC/hardware address of laptop and only allows computers with a MAC/hardware address in a list of approved addresses to connect;
R IP address
Disable broadcast of SSID/identity;
Reduce / limit power of transmitter;

Max 2

- (e) **Subject-related points:**
(Applies to) bus (topology);
Computer monitors/listens to (data signal on cable/bus);
If (data) signal present // if cable/bus busy continue to wait;
When no (data) signal present // when cable/bus idle start to transmit;
Whilst transmitting, computer monitors cable/bus to check for collision // to check if signal is identical to what it is sending;
Collision occurs if two computers (start) sending at same time // if two packets/frames in transit at same time;
If collision detected, jamming signal/signal warning of collision sent;
To ensure other (transmitting) computers aware of problem // to stop other computers sending data;
Computer that detected collision also stops sending data;
Then waits a random period before attempting to retransmit/repeating transmission/this process;
Period is random to reduce likelihood of collision recurring (between computers that caused collision);
If a collision occurs again then waits a longer random time before attempting to transmit again;
Use of exponential back-off algorithm to determine wait time;

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of written communication criteria (QWCx).

- SUB** Candidate has produced a detailed description of how CSMA/CD works, including what happens if there is a collision (at least 5 points).
QWC1 Text is legible.

- QWC2 There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
- QWC3 The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
- QWC4 Sentences and paragraphs follow on from one another clearly and coherently.
- QWC5 Appropriate specialist vocabulary has been used.

5–6

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of written communication criteria (QWCx).

- SUB Candidate has produced a reasonable description which may or may not cover what happens in the event of a collision (at least 3 points).
- QWC1 Text is legible.
- QWC2 There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.
- QWC3 The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.
- QWC4 The candidate has used well-linked sentences and paragraphs.
- QWC5 Appropriate specialist vocabulary has been used.

3–4

To achieve a mark in this band, candidates must meet the subject criterion (SUB). The quality of written communication should be typified by the QWCx statements.

- SUB Candidate has produced a very limited or unclear description of how CSMA/CD works.
- QWC1 Most of the text is legible.
- QWC2 There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.
- QWC3 The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.
- QWC4 Sentences and paragraphs may not always be well-connected or bullet points may have been used.
- QWC5 Specialist vocabulary has been used inappropriately or not at all.

1–2

Candidate has made no relevant points.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of written communication criteria then drop mark by one band, providing that at least 3 of the quality of written communication criteria are met in the lower band. If 3 criteria are not met then drop by two bands.

6

[14]