7.4 External hardware devices part 1 Mark Scheme

Q1.

Marks are for AO1 (understanding)

Level of response question

Level	Description	Mark Range
3	At least five points have been made that shows a very good understanding of both how an image is captured and how run-length encoding is applied.	5-6
2	At least three points have been made that show a good understanding of at least one of how an image is captured and how run-length encoding is applied.	3-4
1	At least one point has been made that shows some understanding of either image-capture or run-length encoding.	1-2

Guidance: Indicative Response

Image Capture

- Light enters through / is focussed by the lens; on to (an array of sensors on) the sensor chip **A.** light sensors capture / record light (intensity) **A.** CCD as sensor;
- Each sensor produces an electrical current / signal;
- The signal represents a pixel;
- An (ADC) converts measurement of light intensity into binary / digital data;
- (Colour) filter is applied to generate separate data values for red, green and blue colour components;
- The pixels are recorded as a group / array;

Run-Length Encoding

- The image is analysed to identify runs / sequences of the same colour / value **N.E.** patterns;
- The colours / values and counts of pixels / values / run-lengths are represented / identified / stored **A.** example;

[6]

Q2.

All marks AO1 (understanding)

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

	three areas indicated in the guidance below and in at least two of these areas there is sufficient detail to show that the student has a good level of understanding. To reach the top of this mark range, a good level of understanding must be shown of all three areas.	
3	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response which shows a good level of understanding of at least two areas indicated in the guidance below.	7-9
2	A limited attempt has been made to follow a line of reasoning and the response has a mostly logical structure. At least four points have been made. Either a good level of understanding of one area from the guidance has been shown or a limited understanding of two areas.	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 areas from the guidance or may be made in a superficial way with little substantiation.	1-3

Guidance – Indicative Response

For each guidance point, if the student expands on the point to explain in what way the measure will improve performance then this can be considered to be a second point. For example:

- "Using a processor with more cores" is one point.
- "Using a processor with more cores which will be able to execute multiple instructions simultaneously" is two points.

Note that just "faster" is not enough to count as an expansion point without an explanation of why.

1. Server Hardware

Replace the processor with one which has more cores

Replace the processor with one which has more cache memory // increase the amount of cache memory

Replace the processor with one which runs at a faster clock speed **NE.** faster processor

Use a parallel processor architecture // use more processors which can work in parallel

Use a processor with a bigger word size

Use a processor that makes (better) use of pipelining

Install more RAM // main memory // primary memory

Use RAM // main memory // primary memory with a faster access time

Replace HDDs with SSDs // Replace HDDS with HDDs that can read data at a faster rate

Defragment the HDD

Replace the motherboard with one which has buses which run at a faster clock speed

Replace the motherboard with one which has more lines in the data bus

Use the Harvard architecture

Distribute the processing across multiple servers

2. Network

Replace the network cable with cable that has a higher bandwidth // replace copper cable with fibre-optic cable **A.** Ethernet cable for fibre-optic NE. higher bandwidth network

Replace any wireless / WiFi connections with wired ones

Replace the network cards with ones that can transmit data at a higher bitrate

Consider the overall network design eg how the network is divided into subnets **A.** split the network into subnets

Use a star topology (instead of a bus)

Consider using a more efficient protocol for the data across the network

Add additional wireless access points

3. Database and Software

Use a more efficient technique for controlling concurrent access to the database // replace record/table locks with serialisation/timestamp ordering/commitment ordering

Replace the database software with software that uses more efficient algorithms for tasks **A.** examples eg replace linear search with binary search

Use the index feature of the database to speed up searching on fields that are commonly used for this purpose

Rewrite the database software in a language that is suitable for concurrent execution // use a functional programming language for the database software

Ensure the software is compiled rather than executed by an interpreter // rewrite the software in assembly language/machine code

Review the conceptual model of the database to see if it contains any inefficiencies such as data redundancy that could be eliminated **A**. normalise the database design

Consider if it would be appropriate to sacrifice normalisation of the conceptual model to improve performance

Use a non-relational database system **A.** examples eg NoSQL

Distribute the data across multiple servers

Try to reduce the amount of other (unrelated) software that might be running on the database server at the same time

Try to reduce the number of database accesses that need to be made simultaneously // run some tasks at quiet times / overnight

Purge / archive data that is no longer necessary / in use

[12]

Q3.

2 marks for AO1 (knowledge) and 4 marks for AO1 (understanding)

Level	Description	Mark

		Range
3	A detailed, coherent, description that covers both the reading mechanism and how data is represented, demonstrating a very good level of understanding.	5-6
2	An adequate description, including at least three points from the list below. The description may cover one or both of the reading mechanism and how data is represented. The description is logically organised so that it makes sense when read as a whole and therefore demonstrates a reasonable understanding of the principles of operation of an optical disk drive.	3-4
1	A small number of relevant points have been recalled (in this case award one mark per point, up to a maximum of two from lists below). The structure of the response, or lack of it, means that only a very limited understanding of the principles of operation is demonstrated.	1-2

Indicative Content

Reading mechanism

- (Low power beam of) laser / light is shone at disk
  NE. implication because it is reflected
- Light is focussed on spot on track
- (Some) light is reflected back from disk
- Amount of light reflected back is measured // light sensor detects reflection
- Disc spins at constant linear velocity // zoned constant linear velocity // variable (angular) velocity
  A. variable speed
  R. constant speed

How data is represented

- Data is stored on one/spiral track
  A. data is read in a spiral
- Continuation of land/pit reflects light whereas transition between land and pit scatters light
  A. land reflects light whereas pits scatter light/do not reflect light or vice-versa
  A. "bump" for "land"
- Transition between land and pit indicates a 1 and continuation of land / pit represents 0
  A. land represents 1, pit 0 or vice-versa
  A. reflection represents 1, no reflection 0 or vice-versa
  A. "bump" for "land" or other wording which clearly reflects nature of pits and lands

[6]

Q4.

Mark is AO1 (understanding)

Flash drives can have a higher (storage) capacity;
R. references that could be to physical size eg "Flash drives are bigger"

Flash drives have faster access / read / write times;
No drive is required to use a flash drive // flash drive and medium are integrated;
Flash drives can be reused;
Flash drives are more compact;
Flash drives not damaged by scratches;
NE. more robust without a reason why
R. points about cost unless they are supported by a reason, such as no separate drive being required
NE. more portable unless this is supported with a valid reason that would not also apply to a CD

[1]

Q5.

2 marks for AO1 (knowledge) and 4 marks for AO1 (understanding)

Level of response question

Level	Description	Mark Range
3	At least five points have been made showing knowledge of five steps in the process. The description shows a thorough level of understanding and all of the steps have been correctly sequenced.	5-6
2	At least three points have been made showing knowledge of three steps in the process. Good, mostly correct understanding of the process is demonstrated between 3 or more steps.	3-4
1	At least one point has been made showing knowledge of one step in the process. Some understanding may be shown if two steps are covered and correctly sequenced.	1-2

Points may include:
Print drum coated in (positive static) charge
Printer generates bitmap of page from the data
Laser beams shone / directed at / draws on print drum
Via rotating (octagonal) mirror
Laser is modulated (turned on & off)
Laser removes / neutralises / reverses electric charge on drum
where image should be dark / black
Toner is given (positive) charge
Charged drum picks up toner
For drum/laser mechanisms, one for each colour (cyan etc)
Toner transferred (from drum) to paper / paper rolled over drum (to transfer toner)
Toner is fused / bonded / melted / stuck to paper (by heated rollers / pressure) (must be clear that toner is already on paper when it is fused, not still on drum)

A. Reversal or lack of polarity of static charge.

[6]

Q6.

Page printer;
Print drum coated in (negative static) charge;
Printer generates bit map of page;
Laser beams shone/directed at/"draws" on print drum;
Via rotating (octagonal) mirror;
Laser is modulated (turned on & off);
Laser removes/neutralises/reverses electric charge on drum; where image should be dark/black;
Toner is given (negative) charge;
Charged drum picks up toner;
Toner transferred from drum to paper; ("from drum" may be implicit in order of answer)
Toner is fused/bonded/melted/stuck to paper by (heated rollers/pressure); (must be clear that toner is already on paper when it is fused, not still on drum)

I. incorrect charges e.g. positive when should be negative

Max 6

[6]

Q7.

Marks are for AO2 (apply)

Mark Scheme

Level	Description	Mark Range
3	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. The response covers both the comparison of car control and painting (see Guidance Table 1) and the use of data for car control (see Guidance Table 2). At least two points from each column of Table 1 have been made and substantiated and at least three sources of input, its processing, the derived information and why it is needed must have been addressed successfully.	7-9
2	There is some evidence that a line of reasoning has been followed. The response is relevant and most but not all points made are substantiated. The response covers both the comparison of car control and painting (see Guidance Table 1) and the use of data for car control (see Guidance Table 2) but one of these two may be covered at a fairly superficial level. EITHER: At least two points from each column of Table 1 have been made and substantiated	4-6

	and at least one source of input, its processing, the derived information and why it is needed must have been addressed successfully OR: At least one point from each column of Table 1 has been made and substantiated and at least two sources of input, its processing, the derived information and why it is needed must have been addressed successfully	
1	There is little or no evidence that a line of reasoning has been followed. Some relevant points have been made but these may only cover one of the comparison of car control and painting (see Guidance Table 1) or the use of data for car control (see Guidance Table 2). If both have been covered, the coverage is superficial and the points made are not successfully substantiated.	1-3

Guidance

Guidance Table 1: Automated car control vs programmed control of a robot for spraying car bodies	
Robot for spraying car bodies	**Automated car control**
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	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 Car system needs to recognise what it sees 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) Car system has to continuously monitor many external variables Car system has to perform very complex processing Car system will need very

numerically controlled	powerful processors

Guidance Table 2: Processing, why, sources of input data, derived information

Source of data: Radar:

Processing:
(long range) radar returns / signals
- Processed to obtain location information of every object over a 360 degree view
- Plotted on a two dimensional map (for further processing)
- Changes in position processed
- Trajectories of moving objects calculated

(long range) radar returns / signals
- Processed to obtain speed of moving objects
- Speed of the car subtracted from the speed of object

Derived information:
- Precise fix on the location of every object
- Distance from objects
- Speed information from changes in position and time
- Speed information from (speed) radar
- Direction information from changes in position
- Trajectories of moving objects

Why?
- To keep car at safe distance from other objects / / to steer car safely
- To negotiate roundabouts / junctions

Processing:
- Radar return / signal processed to obtain speed information of objects
- Speed of the car subtracted from the speed of object.

Derived information:
- A zero result indicates a stationary object, a non-zero result indicates a moving object

Why?
- The car must be able to distinguish moving objects from stationary objects, e.g. pedestrian from fence post

Processing:
(short-range) radar returns / signals
- Separation distance between car and object
- Closing speed on object

Why?
- To avoid collision by applying brakes automatically
- To maintain safe separation distance from objects at sides of car

Source of data: Stereoscopic Camera (at front of car):

Processing:
- Separate images processed to construct view of surrounding area in 3D

Machine intelligence processing used to extract important features

Derived information:

Depth information
Road edge
Road centre
Lane edges

Why?

To predict car's trajectory
Keep car within its lane
Keep car on safe overtaking course

Source of data: High resolution video camera (at front of car):

Processing:

Video frames processed and matched by comparison with a database of road signs

Derived information:

Particular road sign

Why?

Needed to observe highway code
Needed to be aware of junctions, etc.

Source of data: Global Positioning Satellite receiver:

Processing:

Satellite signals processed to obtain location and time information
Comparison made with a stored representation of road system

Derived information:

Position of car relative to junctions, etc
Speed of car

Why?

Needed to observe highway code
Needed to be aware of junctions, etc

[9]

Q8.

(a) **Marks are for AO1 (understanding)**

Solid-state memory chips are more robust;
No reliance on mechanical parts that could fail;
No corruption of data due to magnetic fields;
Faster write speed so more data could be recorded;
Max 2

MAX 2

(b) **Marks are for AO2 (apply)**

1 mark: 8000 * 2 * 360 ;
1 mark: / 1000 ;
1 mark: Final answer: 5760 (KB) ;

OR

Alternative method:

1 mark: 8000 * 16 * 360 ;
1 mark: / 8
1 mark: / 1000;

3

(c) **Marks are for AO1 (understanding)**

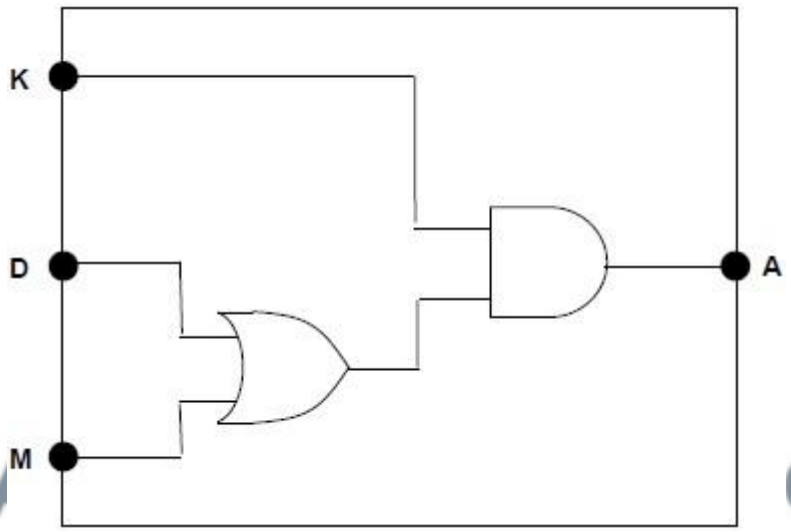
1 mark: Nyquist's theorem / / sample rate should be twice the highest frequency to be stored;
1 mark: With a sample rate of 8000 Hz any audio frequency over 4000 Hz would not be properly measured;

2

[7]

Q9.

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



1 mark: inputs D and M connected to an OR gate;
1 mark: inputs K and output of OR gate connected to AND gate plus output connected to A;
A a logically equivalent circuit

2

(b) **All marks AO2 (apply)**

A = (D + M) · K
1 mark: D + M somewhere in expression, even if full expression incorrect
1 mark: fully correct expression
A A logically equivalent expression

2

(c) **1 mark for AO1 (understanding), 1 mark for AO2 (application) and 1 mark for AO1 (knowledge)**

AO1 (understanding):1 mark: Flip-flop will store the state of its input / / Flip-flop acts as memory;

AO2 (application):1 mark: Insert into circuit between the output of the OR gate and the AND gate / / after the AND gate;

AO1 (knowledge):1 mark: Clock signal / / trigger / / signal to indicate when the value (of the input) should be stored / read;

3

[7]

Q10.

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 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.	10 – 12
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]

Q11.

(a) **MAX 2** for reader:
RFID reader transmits / sends signal // emits electric / electro-magnetic field;
signal activates / energises / induces current in RFID tag;

MAX 1 for tag:
RFID tag transmits data (by radio wave);
RFID tag is passive;

MAX 3

(b) Laser Printer - 3;
Inkjet Printer - 1;

2

(c) **To award a mark a comparison between the two needs to be made.**

Hard disk drive uses magnetic media, CD-ROM is an optical media;
Hard disk drive uses magnetic fields, CD-ROM uses pits (and lands);
Hard disk drive uses magnetic induction (to read data), CD-ROM uses a laser (and sensor);
Hard disk is split into sectors / tracks, CD-ROM follows a spiral track;
Hard disk has multiple platters and read / write heads, CD-ROM single-layered;
Hard disk spins at a fast constant rotation speed, CD-ROM keeps a constant linear velocity / speeds rotation up and down;
Hard disk drive is a read / write medium, CD-ROM is read only;
Hard disk drive and disk are integrated, whereas drive and disk are separate for CD-ROM;
External hard disk connection via cable / usb / firewire, CD-ROM requires a CD-ROM drive;
Hard disk drive can be damaged by exposure to magnetic field, CD-ROM cannot;
CD-ROM can be scratched, hard disk drive cannot;
Hard disk drive can transfer / access data faster than a CD-ROM;

R portability / lightness / physical size

MAX 3

[8]

Q12.

(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).

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.
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 language criteria (QWCx).

SUB	Candidate 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.

3-4

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]

Q13.

General:

The reason mark is dependent on a correct answer for device.
Each reason mark must be different.

USB flash (drive);
A flash drive;
NE USB // flash // USB drive;
Small portable device (that is easily written to and read from);
NE just 'easily transported '
Files would be quite small so will easily fit onto it;
No additional hardware device / drive needed to use ;
Device is robust;
Max 1 mark for reason

2

Magnetic tape (drive);
Can hold large quantities of data;
Not needed for fast access to individual files;
(Media is portable so) archive tape can be stored away from server;
Fast data transfer;
Max 1 mark for reason

2

DVD-R (drive);
Appropriate medium for storing a typical sized executable;
Can only be written to once // cannot be accidentally deleted;
Media is portable (so suitable for distribution);
Max 1 mark for reason

2

[6]

Q14.

(a) A set of rules / regulations (to allow communication between devices) // set of agreed signals / codes for data exchange;
NE a rule // a regulation // a signal // a code
NE instruction(s)

1

(b) Analyses statement by statement each line of source code
A runs / translates / executes line by line
R compiles (line by line)

Calls routines to carry out each instruction / statement

Max 2

(c) Instructions / programs stored (with data) in main memory; **A** memory // RAM

Program run by fetching, (decoding and executing) instructions (from main memory)* in sequence;

Program can be replaced by loading another program into (main) memory

Contents of a (main) memory location can be interpreted as either an instruction or data;

* = This mark can be awarded without the explicit reference to main memory if main memory has already been mentioned elsewhere in the response.

Otherwise, the answer must make clear that the instructions are coming from the main memory to get this mark.

3

(d) LOAD 21
STORE 23

LOAD 22
STORE 21

LOAD 23
STORE 22

1 mark for value from 21 stored into 23;
1 mark for value from 22 being moved to 21;
1 mark for value from 23 being moved to 22;

Alternative :

LOAD 22
STORE 23

LOAD 21
STORE 22

LOAD 23
STORE 21

1 mark for value from 22 stored into 23;
1 mark for value from 21 being moved to 22;
1 mark for value from 23 being moved to 21;
DPT if a different temporary storage area is used
I end of statement separators
Max 2 if the program does not fully work

3

(e) Robots find it hard to adapt to changes in environment // Robots are unable to adapt to changes easily;

Robots find it hard to work with 3D vision;

Robots find it hard to detect edges between similar objects // robots find it hard to perform shape detection;

Robots find it hard to get feedback when gripping items;

Robots find it hard to pick up balls // ball difficult shape to grip // balls can roll away;

Robots have limited processing power // too many variables to deal with;

Programming for vision/grip is a complex problem;
A child builds up experience of using touch / vision;

A Robot cannot recognise when it makes mistakes;
A Robot can't think for themselves // can't perform lateral thinking

Max 3

(f) (i) (Lens focuses) light / photons onto image sensor;
R if uses 'reflection'

Image sensor is a CMOS / CCD / photoelectric device;
CCD used ADC to convert measurement of light intensity into binary;
CMOS uses transistors to generate binary value;
Image sensor converts light into discrete / electrical signals / binary;

Image is captured when the shutter is pressed;
Large pixels collect more electrons than small pixels and so produce better quality images;
Firmware performs data processing to "tidy up" image;
(Colour) filter used to generate data separately for Red, Green, Blue colour components;
Aperture / shutter speed can be adjusted to cope with varying lighting conditions;
Image is recorded as group / array of pixels // Image sensor consists of array of pixel (sensors)//etched into the image sensor's silicon are pixels;

Image data transferred to robot;
Image data usually stored on solid-state disk;

Max 3

(ii) Robot has a low powered microprocessor;

Too much image data for the robot to process quickly // smaller resolution can be processed quicker;

A high resolution image has too much image data for the robot to store // low resolution uses less storage space;

Do not need high resolution to determine colour of balls;

NE allows more images to be stored

Max 1

[16]

Q15.

(a) Magnetic (medium);
Binary digits / bits / 0s and 1s / data represented by magnetising spots on disk // changing magnetic properties of disk;
Disk made up of platter(s);
Disk divided into tracks and sectors;
A either tracks or sectors alone
Tracks are concentric circles // organised into cylinders
Drive head can move in / out // moves to track / cylinder // moves radially;
Disk continuously spinning (while in operation);
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;
Medium and drive / device in sealed enclosure;
Hard disk drive is a random access device;
A Head parked / not over disk when not in use // head must not touch surface when in use;
A Use of cache / buffer to speed up data transfer;

Max 3 if candidate talks about lasers / making holes / pins / engraving

Max 4

(b) 512 MB x 2 = 1024 MB = 1GB
1GB x 1024 = 1 TB

2 x 1024 = 2048

Award mark for a clear movement between MB – GB - TB making use of 1024
;

Final answer: 2048;

Acceptable alternative (as many hard drive manufacturers do not use the 1024 principle) :

1 TB = 1000 GB = 1000000 MB;

1000 000 / 512 = 1953.125;
(mark to be awarded for understanding the calculation needed)

Final answer : 1953.125;

A Accept a final answer that has involved some approximation as a no calculator paper.(2000;)

Alternative

$2^{40} / 2^{29} ; = 2^{11}$;

Max 2

(c) More platters (which are packed closer);
Greater density of data on each platter;
More tracks on a platter // more cylinders;
Change to perpendicular magnetic domains;
Ability to write smaller magnetic domains/parts // smaller read / write heads;
Use of different alloy materials for the platters;

Max 1

(d) Faster access speed // faster booting of operating system //
faster data transfer / read / write speeds;
Silent operation;
Are lighter;
Less heat generated;
Less power required // longer battery life;
Less susceptible to damage from physical shocks //
more robust (due to no moving parts);
A quicker as no need to wait for read / write head to move // sector to be underneath read / write head;
NE quicker (without explanation)
NE better performance (without explanation)

Max 2

[9]

Q16.

(a) (i) Touch (–sensitive) screen;

1

(ii) Smartcard reader // RFID reader // Radio Frequency Identification reader;
Touch (sensitive) screen; (*if not awarded for part i*)

Max 1

(iii) RFID reader // Radio Frequency Identification reader; (*if not awarded for part ii*)

1

(b) Document placed onto glass (pane) // scanner has a glass pane;
Under which is a bright light / rows of red, green & blue LEDS;
and array of optical sensors / CCD array;
covered to exclude ambient light;
sensor array / light moved steadily (under glass) to scan whole document;
the reflected light is converted into an equivalent electrical signal;
more light reflected from bright regions than dark regions;
Link between reflected light and colour explained;

Max 4

[7]

Q17.

(a)

Purpose
To distribute commercial software
To store a 20GB high definition movie file
To use for a 3GB archive of a school server
To create a copy of a music album

Note: Mark first occurrence of each medium

4

(b) **Write**:
To write data a high powered / high frequency laser makes sections less reflective / burns a pit;
R laser writes grooves/tracks;

Read:
A low powered laser is used to read data back from the disk;

Mechanism:
The difference between reflective and non-reflective parts / pits and lands indicates the 1s and 0s;
The data is stored as a continuous spiral track;

One mark each for write, read and mechanism.
Note: a laser is used to read and write data (1 mark only)

Max 3

(c) No hardware exists to read CD-R disks;
The CD-R medium has become corrupted // CD-R is scratched / damaged / degraded;
Support for file format no longer available // no software capable of reading format data stored in CD-R;

Max 2

[9]

Q18.

(a)

40 gigabytes–2 terabytes	magnetic hard disk;
4.7– 8.5 gigabytes	DVD+R;
512 megabytes – 128 gigabytes	flash memory card;
600 – 800 megabytes	CD-R;

A incorrectly copied device names which clearly have the same meaning e.g. “flash memory” for flash “memory card”.

Only mark first occurrence of each medium.

4

(b) Internet connection may be too slow for (a large) download // takes a long time to download;
Download can be interrupted which may cause loss of download;

Worried about security of online shopping ; – *Note: NOT Viruses*
Have physical/permanent copy to reinstall from in case of failure;
A idea that there is a "backup" if computer failure for a BOD mark;
Computer not on Internet // to install offline;

Max 2

(c) Recorded pit size is much smaller;
Spiral spacing on DVD is closer/smaller;
A "groove", "track"
Different wavelength of lasers;
DVD multi-layered / double sided;
A Length of track on DVD is longer;
R More tracks;

Max 1

(d) Data can only be written serially/ not a random access medium;
A sequential for serial;
Locating/finding/seeking data may take too long to be used as online store;
NE slow to read/write

Max 1

[8]

Q19.

Laser
Page printer;
Print drum coated in (negative static) charge;
Printer generates bit map of page;
Laser beams shone / directed at / "draws" on print drum;
Via rotating (octagonal) mirror;
Laser is modulated (turned on & off);
Laser removes / neutralises / reverses electric charge on drum;
where image should be dark / black;
Toner is given (negative) charge;
Charged drum picks up toner;
Toner transferred from drum to paper; ("from drum" may be implicit in order of answer)
Toner is fused / bonded / melted / stuck to paper by (heated rollers / pressure); (must be clear that toner is already on paper when it is fused, not still on drum)
I incorrect charges e.g. positive when should be negative

Ink Jet
Heater behind ink reservoir is warmed;
Vaporises droplet of ink. Expands and forces small ink blob out onto paper;
Electricity applied to piezoelectric crystal;
Deforms crystal shape;
Fires/squirts / shoots spots of ink;
NE places
Some colours produced from mix of ink spots fired together;
Heater turns off – ink cools sucks remainder of droplet back in.
Repeated for all colours and each nozzle;
Electric current switched off piezoelectric crystal returns to original shape;
Print head moves across each line of paper / repeated for each part of each character // Prints line by line;
Ink dries before paper emerges from printer;
A laser / ink jet printer uses (black), cyan, magenta, yellow *(Note – only accept this point once)*

8

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

SUB	Candidate has provided a clear explanation of principles of operation, including at least 7 of the points listed above of which 3 must come from each printer operating explanation.
QL1	Text is legible.
QL2	There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
QL3	The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
QL4	Sentences and paragraphs follow on from one another clearly and coherently.
QL5	Appropriate specialist vocabulary has been used.

7–8

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

SUB	Candidate has provided a clear explanation of principles of operation, including at least 5 of the points listed above of which 2 must come from each printer operating explanation.
QL1	Text is legible.
QL2	There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
QL3	The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
QL4	Sentences and paragraphs follow on from one another clearly and coherently.
QL5	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).

SUB	Candidate has provided a limited explanation of principles of operation, including at least 3 of the points listed above. Candidate does not need to cover both types of printer.
QL1	Text is legible.
QL2	There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.
QL3	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.

[8]

Q20.

(a) (i) A biological / physical / behavioural (**A** by example) property of a person that can be used to identify them / unique;
R examples alone

1

(ii) Fingerprint;
Retina / Iris pattern / scan;
R Eye scan
Facial structure / scan;
R Photo of face
DNA fingerprint / profile;
R DNA
Voice pattern /print;
Ear print;

Max 1

(b) RFID reader/scanner (at passport control) transmits / sends signal;
Signal which activates / energises / induces current RFID transponder / tag;
RFID transponder / tag transmits / sends data by radio(wave);
Electrical / physical contact between tag and reader not required // tag must be near to reader;
Passport may need to be unlocked using Machine Readable Zone(MRZ) / key;

Max 2

[4]

Q21.

(a) Flash Memory (Card);
R memory card

1

(b) Magnetic Tape;

1

(c) CD-ROM;
CD-RW;
A Flash Memory Card if not given in first question part

1

[3]

Q22.

(a) **For Photodiode System:**
Light / laser / LED / Infra-red light shone at bar code; **NE** beam
(Moving) mirror / prism moves light beam across bar code / / user moves reader across bar code; **NE** beam
Light reflected back;
Black/white bands reflect different amounts of light / / black reflects less light / / white reflects more light;
Light sensor / photo sensor / photo diode / CCD measures amount of reflected light;
Light reflected converted into an electrical signal; **A** convert reflection to (binary) numbers / characters
(Electrical form of) reflection analysed to determine value encoded in bar code;
Data transmitted as binary codes to till / computer;
These values are often sent as ASCII codes;

For Camera / CCD System:
Camera / CCD measures (ambient) light reflected from bar code;
Camera / CCD converts light into an electrical signal;
Light reflected back;
Black areas reflect less light than white;
Raw image data transmitted to computer;
Image analysis software analyses image to determine value encoded in bar code;

Max 4

(b) Validate data entry//check bar code is valid/reasonable;
Verify if bar code has been "input" accurately/correctly //check bar code not damaged / altered;
R validate the item

Max 1

(c) Keyboard/Keypad/Touch screen/Concept Keyboard/Electronic Scales
NE scales

1

[6]

Q23.

(a) A (hardware) device that is not part of the CPU;
An external (hardware) device;
A Not built into / part of (main) computer (system) // Outside computer
R Can be connected to / attached to / plugs into a computer
R Examples alone
R Component for device
R Processor for CPU

1

(b)

Peripheral	Input	Output	Input/Output (I/O)
Mouse	✔		

Laser Printer		✔	

1 mark for each correctly placed tick

R Answers with more than one tick on a row.

2

[3]

Q24.

(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).

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

coherently.

QL5 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)

SUB Candidate has provided a limited explanation of principles of operation, including at least 3 of the points listed above.

QL1 Text is legible.

QL2 There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.

QL3 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.

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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]

Q25.

(a)

Typical Capacity	**Storage Medium**
10 Gigabytes – 2 Terabytes	Magnetic Hard disk //magnetic tape cartridge;
10 Gigabytes – 800 Gigabytes	Magnetic hard disk //magnetic tape cartridge;

128 Megabytes – 8 Gigabytes	Flash memory card;
2.8 Gigabytes – 4.7 Gigabytes	DVD-R;
600 Megabytes – 700 Megabytes	CD-ROM;

5

(b) (i) CD-ROM
// DVD-R;

1

(ii) magnetic hard disk
// magnetic tape cartridge
A flash memory card
A DVD-R;

1

[7]

Q26.

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]

Q27.

(a) (i) IP address / Internet Protocol Address;

1

(ii) Uniform Resource Locator;
A Universal Resource Locator

1

(b)
- Forwards / backwards / Navigation – move to a previously viewed page;
- Favourites/Bookmarks – setting up/organising/stores regularly visited sites;
- Options/Tools/Settings – setting up of the Home page / enable/disable features e.g. run JavaScript;
- Home – move to the Home page;
- Refresh – refresh the current page;
- Stop – stop loading the current page / download;
- History – show a list of the last (say) 20 pages displayed;
- Security – change settings / e.g. enable/disable graphics/pop-ups/other content/plug-ins;
- View HTML – source (code);
- Address bar – allows the entering of a URL/IP/web address;
- Search bar – search list for specific web site;
- RSS feeds – receiving content news/updates;
- Application launcher icon e.g. to run email client application;

R HTML editor

Feature followed by NO description scores 0
Good description with feature implied scores 1

Max 2

(c) (i) footyhosting.co.uk

1

(ii) (Each hosted club has) a (sub) folder/directory containing the files for their site;

1

(d) 128 kbps // 2Mbps // 128 kbps AND 2Mbps;
R answers where in addition any other answer is circled

1

(e) (i) (magnetic/server) hard disk/ hard drive;
R removable hard disk
A 'disk' spelt as 'disc'

1

(ii) 8000 GB;

1

[9]

Q28.

Bar Code Reader; *To read the barcode in order to:*
- input item number;
- identify purchased item;
- look up the price of the item;

A add to itemised list, **R** input price,
I stock control process

Credit & Debit Card Reader; *To read the chip (or magnetic strip) in order to:*
- Input account details;
- validate the card;
- authorise the transaction;
- enable payment;

R debit the account

Touch sensitive screen; *including on-screen keyboard*
- To display instructions to the customer;
- Display purchases
- To allow input through on-screen menu selections;
- To enter failed bar codes;

A to activate self check-out; allow interactive product search;

Numeric Keypad;
- For the customer to enter the PIN;

A to type in the bar code if the barcode reader fails

Speech synthesizer;

- To give (spoken) instructions to the customer;
- Printer;
- To provide receipt; **I** other uses

6

[6]

Q29.

The computer might not have a CD Reader;
The computer might not have the software to interpret the data;
The files are in a format which is /file type may no longer in use;
It is 2050 – hardware and software will have changed!
A the data stored on the CD-R could have degraded / could have corrupted
If 'encryption', must say 'no key'

[2]

Q30.

(a) scan head/sensory array moves slowly across the document;
light illuminates document;
image of document is reflected (via mirrors and lens);
onto (an array of) light-sensitive cells // sensors;
each cell/sensor produces an electrical signal;
proportional to the strength of the reflected light that hits it;
electrical signal is converted (into a binary value);
binary values are stored as a matrix/bitmap (*or similar*);
binary value is stored in file;
I pixel
I colour scans // multiple scans
1 mark for each point

Max 4

(b) optical character recognition (software);

OCR not enough
R optical mark recognition
R optical character reader

1

[5]

Q31.

(a) **Processor/CPU;**
Explanation faster execution of (program) instructions / the fetch-execute cycle is faster;
R more 'calculations per second'
Simultaneous processes possible / duel/quad – core processor;

Max 2

Additional processor;
Processing is shared between two processors;

Graphics Card;
Explanation – increasing the speed at which images are rendered;

(main) memory / RAM;

Explanation – reduces main memory to disc transfers;
Fit memory which has a faster read/write speed;

R Clock
A Explanation – increasing the clock speed/over-clocking;
R Cache
A Explanation – program instructions are fetched faster from cache than main memory;

(b) **Secondary storage/memory/disc store** // **(external) hard disk**;
A HDD/ Hard drive
Explanation – the storage space/capacity is increased;
R: 'bigger hard drive' or similar

2

(c) **Hub device / USB ports**;
Card with additional serial /parallel ports / PCMCIA / USB ports;
R Card with additional I/O ports
Explanation – will allow/support the simultaneous connection of several devices;

Max 2

[6]

Q32.

(a) Data storage not immediately/directly accessible to the CPU;
A Permanent / non-volatile data storage *or a description*
R an example, 'permanent', 'non-volatile'

1

(b) (i) **Flash Memory;**
Compact;
portable;
direct access;
Read/Write medium; **A** edited / updated
A capacity specified;
A (External)Hard disk; large capacity/direct access/fast access/portable;
R DVD-R

Max 2

(ii) **DVD-R;**
Ample capacity of DVD-R;
Direct Access;
Cannot be deleted / over-written;
Can be played on a DVD player;
Does not need to be on-line;
Inexpensive;
Easy to copy;
A compact, offline, easy to post
R mag tape

Max 2

(iii) **Hard disk;** *if not given in (i)*
Fast access;
Needs to be on-line;
Large capacity;
Direct access;

Max 2

[7]

Q33.

Input devices: up to 3 devices which, between them, cover the specified tasks (no duplication)

Bar code reader;
To identify the purchased items;

/**Bar code scanner**
To capture the product code;
A check / get price

2 marks

Touch screen;
To select method of payment;
Manually input information (*relevant to context*)
A to select item for purchase;

2 marks

Credit / debit /smart card reader / keypad;
For entering the PIN;
Capture the card data;

2 marks

A Trackball; to select method of payment / select item for purchase;
Keypad only accepted with role (to enter PIN)

[6]

Q34.

(a) **RFID**
Cut down on theft;
A prevent (Bod)
Cut down on money laundering;
Cut down on lost items/ can identify found items;
Ability to track goods being sent around the world;
Keep supermarket shelves stocked;
Easier for fork lift trucks to find the correct item in a warehouse;
Know customers' purchasing habits;

1 mark for each of 2 benefits to max

2

(b) If your pet is lost / stolen, it can be identified;
Less chance of your baggage going astray;
Lost items more easily retrieved / found;

benefit

1

(c) Loss of privacy / can be tracked wherever you go;
Powers that be' know where you spend your money;

1 concern

1

[4]

Q35.

Device	use	why
RF Remote Control	User can switch appliances/lights on (and off from a distance) // open/close doors/curtains;	does not have to be in line of view; (as with an infra-red device)
Movement Detector	Lights could switch on as user is approaching a new area // Doors could open on approach;	would be difficult for a wheelchair bound person to reach the doors/lightswitch;
Voice recognition system	To open/close doors/curtains // activate lights;	User could speak commands rather than pressing buttons // Don't have to reach button;
CCTV	See who is outside/rang the doorbell;	Without going to the door;
Fingerprint door locks	To control who gets through the front door // to lock/unlock front door;	without needing a key;
Climate control system	to get fresh air // control temperature in house automatically;	No need to open windows // no need to adjust air con/heating manually;
Motors to operate doors/curtain rails	Can control opening/closing of garage door/door/curtains;	would be difficult for a wheelchair bound person to reach the doors/curtains; without the use of manpower; **A** for client to move around more easily;
Switching Unit	To switch on motors for curtain rail when it gets dark/ at certain times of day // to program the switching on of lights/heating/multimedia system/ according to times of day/week ;	Automates daily/regular activities so less to do manually;

C/F or C/B between 'Use' and 'Why'
Note: 'would be difficult for a wheelchair bound person' on its own NE. Needs context of use.

2 marks max for each explanation

[6]

Q1.

The workings of a digital camera were generally well known, with many students receiving 3 or 4 marks. Run length encoding is also well understood, but frequently a lack of clarity is demonstrated with students referring to patterns of data or the same data in a row. Neither of these was specific enough to be awarded a mark.

Q2.

A very good range of responses was received to this question, with approximately half of students achieving five or more marks. Most students addressed all three aspects of the question (hardware, network, database and software). Students tended to make more points about how the hardware could be improved than about the other two areas. This was acceptable but students needed to have covered all three areas to achieve a mark of ten or above.

Some students wrote too vaguely to achieve marks, for example by writing that a “faster processor” would improve performance, without referencing a factor such as the clock speed that would make the processor faster. Other mistakes included believing that the question required students to contrast thin-client and thick-client and that the system was web based.

A small number of students wrote about issues which might be causing the system to perform poorly instead of explaining how the performance of the system could be improved. Such responses were not worthy of a mark.

Q3.

The vast majority of students showed some understanding of how optical disks worked, with over three quarters achieving some marks, but relatively few showed a good understanding, with only a fifth of students achieving more than half marks. Most students were aware that the data on the disk was read using reflected laser light, but descriptions of how the data was represented on the disk were less good. A small number of students wrote about magnetic disk storage instead or a device that sounded like a record player.

Q4.

Just over three quarters of students achieved a mark for explaining a reason why USB Flash Drives were a more popular choice the CD-Rs for transferring data. Good responses included reasons such as higher storage capacity, re-writability and the fact that no drive is required. Some points required further explanation than students gave to achieve a mark, for example points about robustness, as arguments could be made both ways about whether a Flash Drive or CD-R is more robust. When discussing capacity, students are advised to use the word “capacity” instead of the word “large” which could be a reference to the physical size of the device.

Q5.

Despite being specifically identified in the specification, a large number of students showed a lack of understanding of the workings of a laser printer. In some cases, students referred to ink rather than toner which lost some marks. However all too often a lack of understanding was shown with many students believing the laser burnt the paper to make the mark, or burnt the toner onto the paper to make the colour. In some examples

students suggested that the laser burnt an outline which was then filled in with toner. It is suggested that all students have sufficient understanding to answer this level of question about each of the hardware devices identified in section 3.7.4.1 of the specification.

Q11.

Questions based around hardware devices continue to be answered poorly in comparison with other topics from COMP2. There are students who are not secure in the key differences between the hardware devices this exam paper covers.

Students who could present the idea that the RFID reader emits a radio signal which activates a tag in close proximity secured two marks. The third mark came from describing the tag sending some data back to the reader.

Across the weaker students it was common to see ideas such as barcodes, lasers, infra-red and scanning being discussed even though the question explained RFID as radio frequency identification system.

Comparing CD-ROM to hard disk drive continued to show some confusion. Good students could clearly point out differences by comparing from both sides. Weaker students would only provide a statement such as 'CD-ROM is read only' and not provide a full comparison.

It appears that the operation of a CD-ROM is understood better than a hard drive with many being able to talk about the role of the laser. It appears that some students think that hard drives are also read by pins or lasers rather than the idea of a read / write head floating over a disk.

Part (b) was answered well by students with the majority securing both marks.

Q12.

(a) This part was answered very well by candidates with the majority responding with keyboard and touch-sensitive screen as manual input methods for a barcode. A few candidates responded with mouse as one of their devices and this was not accepted as this would not be an appropriate input device, with the context of a supermarket checkout. Weaker responses also included a variety of scanning devices and just plain monitor / VDU.

(b) This part provided candidates with a good opportunity to demonstrate an understanding of the principles of operation of a bar-code scanner. It was pleasing to see candidates structure their work well and provide clear statements about a light source, the reflection of light, the sensing of the reflection and the conversion of this into an appropriate digital form.
The role of the check digit was less well known and this separated the candidates by marks achieved. It was pleasing to see that candidates could describe how a function would be applied to the first 12 digits to generate a digit which would then be compared to the original check digit. For some candidates there was confusion as to what a check digit actually was and a few decided to talk about parity and the numbers of 1s and 0s in the binary. Weaker candidates spent time discussing the looking up of a product in a database to find the details and also sometimes included some discussion around stock control.

Q13.

The average mark this question was nearly 4 marks out of 6 and this proved to be a question that most students could have a good attempt at. Students usually gained marks

for identifying the three devices and then provided a good reason or two. Quite a lot of students failed to gain marks for the backup scenario as they picked the internal hard disk drive as the device. While hard disk drives can be used for backups, the expectation was that students would realise and explain that you would not use an internal hard disk drive for backups in case of fire or flood destroying the server, and therefore the backup at the same time.

To distribute software, the majority of students identified that the correct answer was DVD-R and a good answer included a reason along the lines that the distributed software would then not be able to be edited or written over. There does appear to be a common misconception that an item that is read-only cannot be copied and answers such as 'the software cannot be copied' were seen quite a few times.

To improve on answers students should be encouraged not to use short answers such as just 'easier', 'quicker' or 'cheaper' but to look to add more depth to their answer by providing some justification.

Q14.

This question asked students about a variety of topics all linked back to the idea of robotics. Over half of all students correctly provided a definition for protocol and the clearer answers linked this to the idea of an agreed set of rules to allow communication between devices. Some students who failed to secure the mark answered along the lines of instructions and programs rather than the idea of communication.

Part (b) asked students to identify how a HLL interpreter works. It was perhaps surprising that only half of the students managed to secure at least one mark on this question. It is clear that students got confused with the differences between a compiler and an interpreter with, some students answering this question by stating that it would 'compile'. Answers that just stated that 'it would interpret code….' also failed to secure marks. How an interpreter works beyond just translating code line by line is clearly not well understood and perhaps is an area centres could be encouraged to look at further.

Part (c) asked about the stored program concept. As a topic included in the name of the examination unit it was surprising to see that less than half of the students secured a mark on this question part. Of the credit worthy points made, it was common to see the idea that instructions are stored in the main memory of a device. A few students then went on to correctly identify that instructions are then fetched and executed by the processor. It was pleasing to see some students then discuss that the stored program concept allows different programs to be switched in and out of memory providing the ability to run different programs.

Unit 2 looks at only three machine code instructions and these were all given on the question paper in part (d) as a reminder to students. The correct answer only needed use of the LOAD and STORE instructions and over half of all students secured all three marks for this question part. A common mistake was to just see an answer of the form 'LOAD 21 ADD 22 STORE 23' showing that perhaps a student did not understand what the question was really asking them to perform which was swapping two stored values around.

Part (e) was a question looking at the differences between robotics and how we cope with situations. It was pleasing to see students identify aspects such as robots finding it hard to get feedback when gripping an item, and the problems in separating two similar coloured balls when they are obscuring each other. An answer that was rarely seen was the idea of a child building up experience over time and learning, compared to a robot just being programmed.

Students continue to struggle with identifying the major principles of how hardware

devices work and it was common that no marks were achieved when discussing the digital camera and nearly 10% left this question part blank. Better answers considered items such as the shutter opening and closing to capture the image and correctly identifying the use of a sensor with more able students stating that this would be a CMOS or CCD device. It was surprising to see a few candidates talk about the use of film to capture the image.

The second part to the digital camera question was answered well and it was clear that students could link the idea of low resolution images to the needs of a robot. The simplest answer was to talk about the lower storage space required but the more able students linked this to the robot being able to process this amount of data faster or even that to identify colour differences would not require high resolution. Students should be encouraged to express their answers with direct reference to a question context, when appropriate, as this does allow them to demonstrate their understanding at a higher level.

Q15.

A substantial number of students secured no marks for describing how a hard disk drive works even though this question has been asked in a similar way before. A lot of students were too vague in their answers and failed to use terminology correctly. Many students also seem to be of the view that hard disk drives use lasers and sometimes tape.

More able students gave in-depth answers which clearly talked about the media being magnetic and used terminology such as platters, tracks and sectors. Weaker students either tended to talk about lasers or just answered about the use of a hard-drive to store data rather than how it works.

It was pleasing to see how many students secured full marks for the calculation required in part (b). Those that worked up the units using 1024 multiples found it quite easy to then see that the final answer was 2048. Many students used multiples of 1000 and still secured marks with a final approximate answer of 2000. As the specification mentions storage capacities, this question asked students to show their understanding of how we can move from MB to GB and then to TB. For this particular question we accepted responses in which students assumed that 1000GB = 1TB as this assumption is made by many hard disk drive manufacturers which was the context of the question. Students should not assume that we will accept this simplification in future questions.

As was to be expected, given the lack of understanding demonstrated by some students in question part (a), responses to (c) were mixed. Students mostly gained marks for discussing how the amount of tracks might have changed or identifying that there could be multiple platters. There was some confusion over the use of layers and this might link back to students thinking that lasers are used.

The majority of students managed to secure at least one mark when talking about the advantages that a solid-state drive might bring. The most common answers talked about data access being faster or considered the fact that a solid-state drive would be lighter and consume less power. Weaker answers did not give enough information and included vague observations such as ‘it is faster’. A few students commented on the fact that this kind of drive would be non-volatile, identifying another misunderstanding of magnetic hard-drives.

Q16.

The majority of students secured all marks for question part (a) as they correctly identified the input devices needed. It is to be noted that a few students did not know what a flatbed scanner is and used this as an answer for a part of (a) and then also scored poorly in part (b).

Students were asked to discuss the principles of operation for a flatbed scanner for part (b) and it was pleasing to see more students gaining marks than in previous papers. It is clear, however, that some students still do not understand the purpose of a flatbed scanner; answers ranged from using lasers (with the assumption that a scanner is a printer) to working with barcodes in a supermarket. It also appears that there is confusion as to the correct principle where light is reflected compared with light actually passing through the document to sensors on the other side. Students who secured full marks correctly identified the major parts of a flatbed scanner and could describe how a document would be scanned.

Q17.

Students generally scored very well when completing the table of different storage media. Students who dropped marks tended to place CD media into the 3GB row and therefore not appreciate fully the different storage capacities.

When describing the workings of a CD drive it was clear that the majority of students appreciate that it uses a laser to read and write the data. To secure two marks, however, students needed to differentiate between the power of the laser being used in the read and write processes. Students who clearly described the difference on the physical media to represent binary 0s and 1s picked up the mechanism mark. Weaker students provided answers along the line of, 'pits store 0s and 1s,' and did not distinguish between pits and lands. A minority of students continue to mix up optical and magnetic media and wrote about magnets being used to write or read data. A few students described needles being used to scratch data onto the disk perhaps remembering vinyl records.

Question part (c) was generally answered well with the majority of students securing at least one mark. The most common answer was along the lines of the CD becoming damaged or scratched. Students need to be aware, however, that to gain a second mark they need to identify a different point from the first. A CD becoming scratched and a CD becoming damaged are not different enough to secure two marks. Students who recognised that the file format might no longer be supported secured a mark. There was slight confusion for a few students who stated that a DVD drive would not be able to open a CD.

Q18.

Part (a) asked candidates to identify the storage media that most closely matched a provided capacity range. Most candidates scored well on this question and the majority correctly identified the magnetic hard drive and CD–ROM. The most common mistake was to provide the answer of Blu-ray for the 4.7–8.5 GB capacity whereas the correct answer was DVD+R. A single layer Blu–ray disc has a capacity of 25GB with dual layer discs having a capacity of 50GB.

A large number of candidates failed to secure any marks for part (b). Good candidates wrote about the fact that a customer might have a slow Internet connection or that to download a large software file would take a long time. Some candidates gave the creditworthy answer that the customer might not even have an Internet connection. A lot of candidates wrote about the DVD being a backup, but did not fully explain their answer. A DVD would be a backup if the customer deleted the downloaded file or the computer had some sort of failure. Whilst most candidates attempted the question, many only made one point in their answer when the question was worth two marks. Candidates should always look at the allocated marks for each question part and use this to guide their answer. It is to be noted that quite a few candidates gave answers concerning movies, piracy and the illegality of downloading. The question was clearly framed in terms of a customer buying software rather than the context of downloading of movies.

Part (c) looked to examine the workings of a DVD disk compared with a CD. Strong candidates tended to understand the major differences between how data is stored on a DVD compared with a CD. Answers included smaller pit sizes, smaller wavelengths of laser and the narrower spacing of the spiral track. Weaker candidates again struggled to understand the workings of hardware devices and this was seen in their answers to this part. Answers were vague with candidates just stating, for example, that DVDs store videos and therefore need more storage than CDs that store sound. A few candidates tried to describe the CD and DVD as magnetic media rather than as optical. At AS level, examiners do expect candidates to have an understanding of the workings of the major hardware components that are listed in the Teacher Resource Bank.

Part (d) was looking to test candidates' understanding of the major differences of using magnetic tape compared with a hard disk. Strong candidates knew that a magnetic tape stores data serially and therefore accessing specific records would take a long time compared with the direct nature of a hard disk. Weaker candidates did not spot the point of the question and provided answers based around the word 'audio' and how this was not appropriate for storing computer data.

Q19.

This question was poorly answered, with many responses focusing on the relative merits of the two printer types rather than the principles by which they operate.

Candidates who scored well clearly understood the workings of a laser printer, but often still struggled to write about an inkjet printer. Candidates could score only 4 marks for describing one type of printer.

Whilst the principles of operation of a laser printer were better known, quite a few candidates wrote about the laser burning the image onto the paper. A few candidates also seemed to have the impression that a laser printer needs no ink/toner and therefore is more cost effective. The majority of candidates struggled to explain correctly the use of the drum inside a laser printer. It was common for candidates to believe that the toner went straight onto the paper rather than onto the drum first.

Given the widespread use of inkjet printers, it was surprising to see how many candidates could not explain how one worked. Candidates who gained marks generally mentioned the fact that they worked line by line. Good candidates described the squirting or firing of ink but weaker candidates used terms such as 'place and drop' and did not do enough to secure a mark. Most candidates who described the cartridge colours did manage to secure a mark for this, but it was still common to see wrong colours mentioned.

A few candidates did not attempt this question at all, whilst some provided only a few sentences for an 8 mark question.

Q20.

This question covered biometric properties and RFID use. It is a question that has not been asked before and this often showed in the answers offered. What the term biometric property means was frequently answered with ideas that were either not biometric or not unique, especially when the candidates attempted to answer the second part of the question in the first part of the answer. When asked to give an example of such a property many more gained credit – but there were still far too many that included ideas such as passport numbers or National Insurance numbers etc. When asked how the RFID tag could be read at an airport appeared to think the tag in the passport initiated the whole process rather than the reader. Some candidates seemed to be answering a question that was not asked by simply listing what data might be held on the tag.

Q21.

Most candidates were able to match the storage devices to their uses, successfully. However some candidates included devices that were not in the list on the question paper in their responses, thus losing marks by not reading the question.

Q22.

This question was often answered by describing the entire system including the database lookup and printing the till roll which was clearly not what the question was asking. Candidates should read the question carefully before starting to answer. The question was quite clear in that it asked about the bar code reader and even gave an end point to the process stating, “excluding the use of the check digit.” Many answers concerned general stock control and automatic ordering systems which are more of an ICT-type answer than one expected from Computing candidates. A good number of candidates thought that the reader played some role in the security system somehow switching off RFID tags in the goods that were being scanned. At the other extreme, there were also many answers gaining full marks for very cogent descriptions.

Part (b) was answered quite weakly and approximately 15% of candidates did not attempt to answer it at all. Where the question was answered it was often incorrect with candidates believing that the check digit was the whole of the printed number below the bar code and its purpose was to allow the cashier to enter the number if the bar code had not scanned correctly. The check digit is in fact used to validate the input of the bar code. The idea of deactivating RFID tags also appeared here quite often.

Q23.

Some candidates provided an accurate technical definition that a peripheral is a device that is not part of the CPU. A more frequently seen response that was also allowed was that a peripheral was an external device. Responses indicating that peripherals were devices which plugged into or connected to a computer did not gain credit as this description could be applied to the processor and main memory. Candidates also need to make clear that peripherals are devices. The most common misconception was that all peripherals were designed for user interaction.

The overwhelming majority of candidates correctly identified a mouse as an input device and a laser printer as an output device. A small number classified a laser printer as being an input / output device. This did not gain credit as, whilst it is true that most printers provide feedback to the computer, devices are classified by their primary function.

Q24.

Some candidates provided good descriptions of two differences between primary and secondary storage, but, the majority failed to score any marks and a significant number clearly had no idea what the terms meant. The most common acceptable response was that primary store was volatile whereas secondary store was non-volatile. Some candidates gave the opposing side of the same point for each response and were therefore only able to gain one mark.

It is not true that secondary storage is always external or removable; nor is it universally the case that secondary storage devices have a higher storage capacity than primary storage. A CD-ROM or flash memory device may well have a storage capacity smaller than the primary store in the computer in which it is being used. To ensure that credit is gained, candidates need to make sure that differences are universally true, not just true in some specific cases.

The level of detail in descriptions of the principles of operation of a hard disk drive was limited.
Many candidates described characteristics such as typical capacities and uses rather than principles of operation. Most candidates expressed themselves fluently so the general quality of language was good. However, candidates often lost marks because they could not use technical terms such as sector or platter precisely. Many candidates used the term needle instead of read / write head. The most common misconception was that a laser was used to read / write data. Even candidates who described the medium as being magnetic sometimes referred to pits on the disk or the use of a laser.

Q25.

Some candidates failed to achieve marks because they took no notice of the media listed in the question and suggested others or used variations of terms. It is not acceptable to use the term ‘hard drive‘ when the question provided the term ‘magnetic hard disk’ nor is it acceptable to substitute ‘CD-R’ for ‘CD-ROM’.

Q26.

Candidates found this question difficult. Many seemed to be under the misconception that barcodes or magnetic stripes are incorporated into RFID systems. Considering that this method of identifying items is so frequently used nowadays it is sad to see that so few candidates were aware of the technical aspects and had no idea of the principles of operation of RFID tags. Most candidates concentrated on the fact that it would trigger an alarm bell; this fact, however, did not gain credit. The reader near the exit sends a radio frequency wave which the antenna of the RFID tag in the book receives when it comes within range. This energises the tag and then the transponder in the tag sends a data signal that the reader receives. Candidates should be aware that the tag in the book does not continually send out a signal.

Q27.

(a) Generally this question was consistently well answered.

(b) The marks were given were this time for a description of the feature (not just stating the name of the feature as in previous papers). The most popular answers were 'Page Navigation', 'Favourites', and 'History'. Some candidates did describe a feature which was not browser-specific such as 'Help' or 'Print', ignoring the rubric in the question stem.

(c) Any candidate who had practical experience with website construction would not have found a problem in identifying the use of folders/directories. Wrong answers, including vague answers, were 'by having a home page for each club', 'a home page with links to each club,' or, 'by having the club name at the end of the URL.'

(d) Most candidates achieved the mark, although seriously wrong answers included removable drives, DAT and even 'hard copy'!

Q28.

Many candidates gained all or most of the marks available for this question, but there were classic mistakes. A bar code does not contain the price of an item. The bar code is scanned in order to input the item code which is used to look up the price and description on the database. A credit / debit card reader does not actually debit the money owed from the bank account. It reads the account details in order to validate the card and authorise the transaction. A touch sensitive screen is more than an input device; it can display

instructions to the customer and display the list of purchases, as well as allowing customers to make selections.

A numeric keypad would be used to enter the PIN or, conceivably, the item code if the bar code failed to scan. It is unlikely that customers would enter how many of an item they were buying. In fact, some candidates talked about a member of staff entering the quantity of items, ignoring the fact that the whole point of the question was that customers checked their goods out for themselves. A number of candidates confused a speech synthesizer with speech recognition, or suggested it could be used to give instructions to blind customers – who would find it difficult to use such a system anyway – and even to the deaf.

Some candidates did not gain marks as they simply said what a device would do 'A numeric keypad is, 'to input numerical data.'' Other candidates' answers referred back to a question in a previous examination series.

Q29.

This question was answered well. Many candidates appreciated that hardware and software is changing so fast that current storage media and file formats could become completely obsolete by 2050. Some candidates lost marks by saying that the disk drives would not read CD-Rs; candidates should distinguish between disk drives and CD-Readers.

Q30.

Very few candidates had a good understanding of the principles of operation of a scanner. Most could state that a light is shone at the document, but too often that was the extent of their technical knowledge and too much emphasis was given to how a document was placed on the scanner and which buttons had to be pressed. There seemed to be a widespread misconception that the light of the scanner shines through the paper onto a reflective surface on the other side. Candidates obviously have little experience of scanning anything other than single sheets of normal paper. Acceptable answers should have included the following information:

- the scan head moves slowly across the document, illuminating the document
- the image of the document is reflected onto light-sensitive cells
- each cell produces an electrical signal proportional to the strength of the reflected light and this electrical signal is converted into a binary value
- the binary values are stored as a bitmap in a file.

Part (b) of the question was also done poorly by a large number of candidates. Optical character recognition software is required to convert a scanned image into word processor useable text.

Q31.

In part (a) the most popular answers were 'processor' and 'RAM' but few candidates were able to give a convincing answer for the second mark, often merely re-stating the words in the question stem that the processor would 'increase the speed of execution of the program'. A good explanation for RAM was rare; candidates clearly have the knowledge that more RAM should result in the faster execution of a program but not the reason behind it.

The most popular answer for (b) was some form of hard drive with this time candidates usually able to get the second mark for a simple statement that it will, 'increase the storage capacity,' but note 'bigger disk' was not considered sufficient (a good example where clear quality of expression gets the mark).

For (b) 2 marks were rarely scored. Candidates who had used a USB on their computer would have identified with this question straight away, but an answer stating that the devices can be then ‘simultaneously’ connected was often missing.

Worryingly, as the content would seem to be at the heart of the subject at this level, there were a noticeable number of scripts which did not attempt some or all of this question. The distribution of candidate marks indicated that this question proved to be a good discriminator of candidates’ ability.

Q32.

Secondary storage is non-volatile data storage not directly accessible to the processor. A number of candidates defined it as removable, which ignored the hard disk. ‘Storage used for back-ups’ was similarly not credited.

There were good responses from many candidates to part (b). One answer which conveyed the essential information was: ’(i) Flash memory – ‘Highly portable due to its small size so can be carried around in a pocket; can be used with any computer that has a USB port; (ii) DVD-R – Easily replicated and cheap to do so. Contents can also be viewed in numerous ways such as on a PC or new DVD players; (iii) Magnetic hard disk – large storage space for a lot of software. Data can easily be shared across a network.’

Some answers were less complete, and some media choices were not appropriate.

Q33.

This question was asking candidates to suggest three input devices to fit particular criteria; in this case where space was at a premium and there were specific tasks to be done. Many candidates gained full marks, but marks were lost by candidates who did not read the stem carefully. Although the question asked for input devices, various forms of printer were suggested. A few candidates suggested keyboards although the stem specifically said there were none. Some candidates gave two different credit / debit card readers and OMR and even MICR cropped up rather frequently.

Candidates also lost marks by not being specific as to why a particular device would be appropriate. A significant number said that the barcode held information such as price and description, rather than passing the code to the system for such information. A ‘barcode scanner to scan barcodes’ gained one not two marks.

Q34.

Few candidates gained all 4 marks for this question. Some candidates did not seem to be able to distinguish between benefits to an organisation and benefits to an individual, although a number had second thoughts and indicated that their answers should be reversed. Many candidates did not appear to realise that the RFID needed a special reader to receive the signal, so the idea that lost pets, criminals, or even the general public could be tracked and found did not gain credit. Another problem with this question was in not reading/understanding the phrase ‘small chip and an antenna’. In practice these are very small – the animal ones going down a large diameter hypodermic needle and hurting the animal no more than any other injection.

Centres are asked to note that this paper is now electronically marked, and are asked to

ensure that candidates use a good blue or black ink which will scan in clearly.

Q35.

This question was generally done well. However, few candidates saw the significance of the radio-frequency remote control. Answers worthy of credit needed to highlight the usefulness of this device over other remote controls which require the control to be in line of view of the device to be controlled. Very few candidates could suggest any use for a programmable switching unit, often expecting the user to sit at a computer to control this unit, rather than the expected answer of pre-programming the switching of lights/heating/multi-media etc according to times of day/week.

The reasons given for using any of the components was often just re-iterating the question stem (the client cannot stand easily and has limited use of their arms). Candidates need to be reminded that this will not gain credit and that further explanation is expected, such as a wheelchair user may find it difficult to open windows as they find it difficult to reach handles and push/pull.