(b)

description of stage	sequence number
the instruction is then copied from the memory location contained in the MAR (memory address register) and is placed in the MDR (memory data register)	**3**
the instruction is finally decoded and is then executed	**7**
the PC (program counter) contains the address of the next instruction to be fetched	*(1)*
the entire instruction is then copied from the MDR (memory data register) and placed in the CIR (current instruction register)	**4**
the address contained in the PC (program counter) is copied to the MAR (memory address register) via the address bus	**2**
the address part of the instruction is placed in the MAR (memory address register)	**6**
the value in the PC (program counter) is then incremented so that it points to the next instruction to be fetched	**5***

The incrementation of the program counter can appear at any stage after 2. All other stages must be in the correct given order. [6]

8 (a) hours: **18**

minutes: **53** [2]

(b)

hours (**"C"**)									minutes (**"D"**)							
0	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**:**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**0**

[2]

(c) Any **three** from:

– reads values in registers “C” and “D”

– and checks the values against those stored in registers “A” and “B”
(**NOTE**: the first two statements can be interchanged, i.e. “A” and “B” read first)

– If values in corresponding registers are the same

– the microprocessor sends a signal to sound alarm/ring [3]

(d) Any **three** from:

– uses a light sensor

– sends signal/data back to microprocessor

– signal/data converted to digital (using ADC)

– value compared by microprocessor with pre-set/stored value

– if value < stored value, signal sent by microprocessor …

– … to the voltage supply (unit)

– … “value” of signal determines voltage supplied/brightness of LED [3]

(e) Any **two** from:

– no need to warm up

– whiter tint/more vivid colours/brighter image

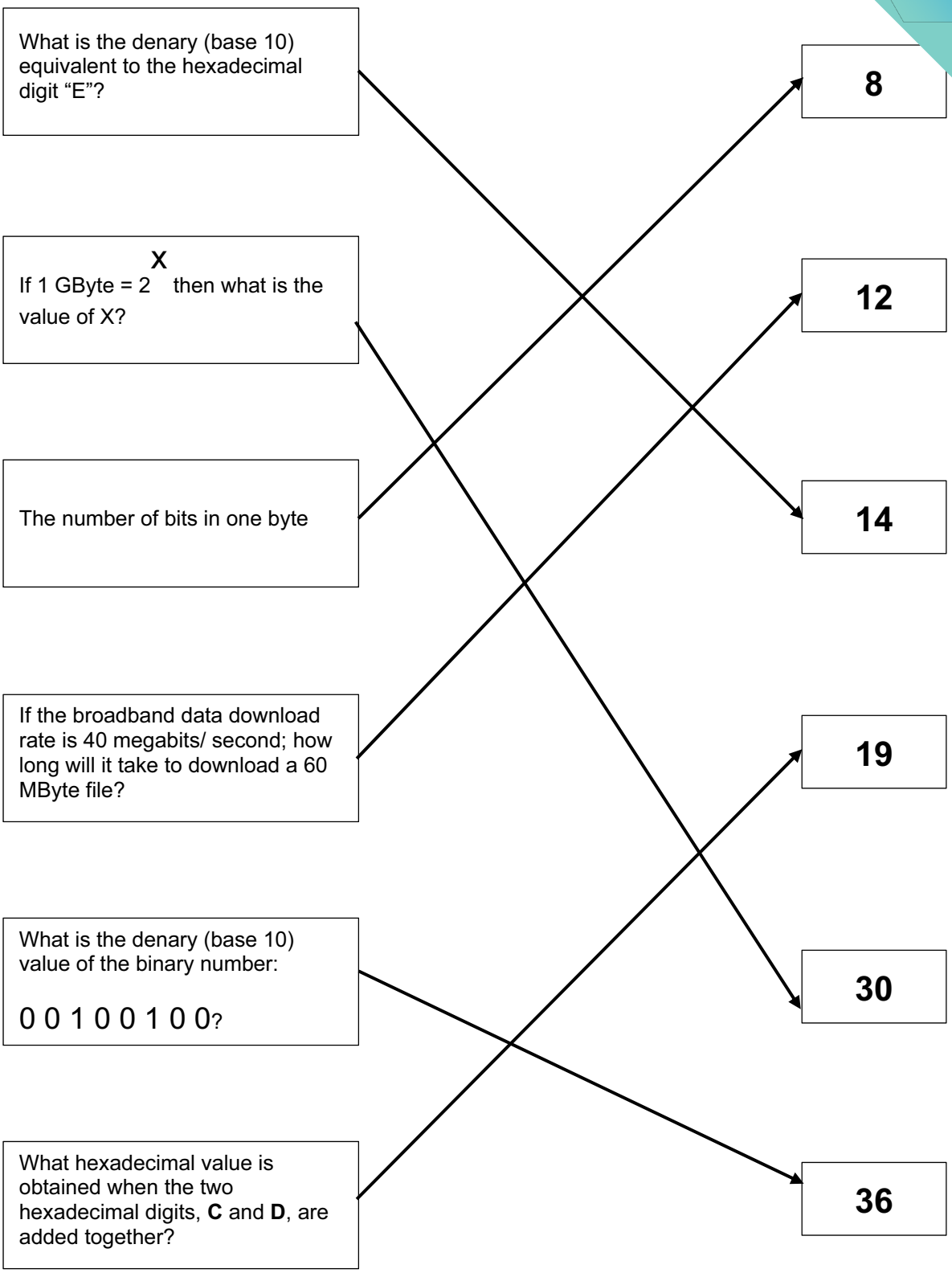
– higher resolution

– much thinner monitors possible/lighter weight

– more reliable technology/longer lasting

– uses much less power/more efficient [2]

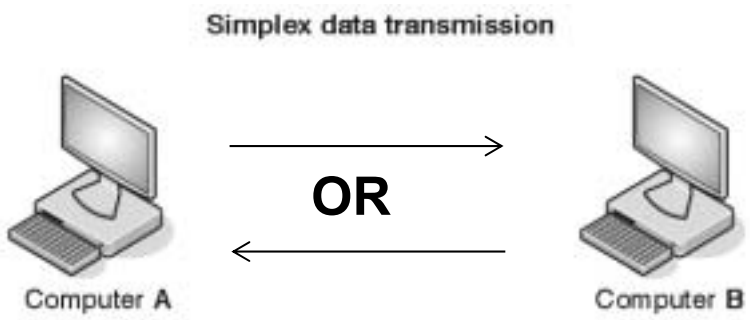
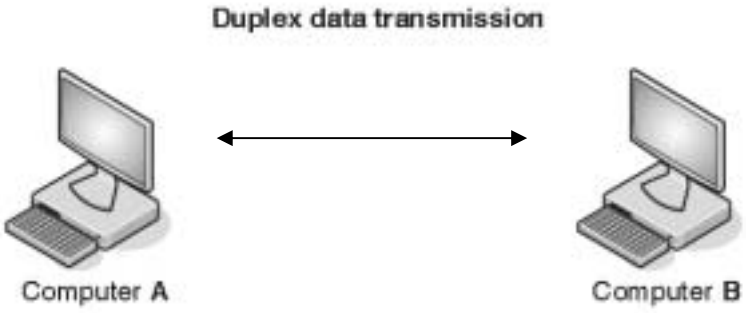
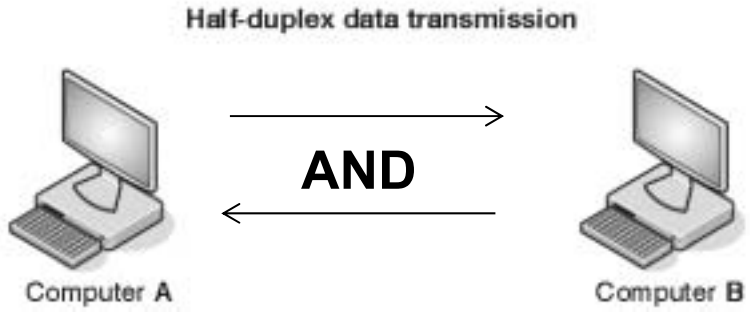
9



5/6 matches – 5 marks
4 matches – 4 marks
3 matches – 3 marks
2 matches – 2 marks
1 match – 1 mark

[5]

QUESTION 2.

Question	Answer
7(a)	1 mark for correct arrow(s), one mark for correct description  (Direction of data is) one way only // unidirectional  (Direction of data is both ways) <u>at same time</u> / <u>simultaneously</u> / <u>concurrently</u>  (Direction of data is both ways) but at different times / <u>not at the same time</u> / <u>not simultaneously</u> / <u>not concurrently</u>

Question	Answer	
7(b)	1 mark each use, must be different. **Simplex** e.g.: Microphone to computer Sensor to computer Computer to printer Computer to speaker Computer to monitor Webcam to computer Sending data to a device // sending data from a device **Duplex** e.g.: Telephone call Voice over IP Computer to printer (only award once) Instant messaging Broadband connections Video conferencing Sending data to and from devices e.g wireless technology Computer to modem	
7(c)	2 marks for IC, 2 marks for USB **IC** • parallel transmission // description of parallel • for sending data internally **USB** • serial transmission // description of serial • for sending data externally (to and from peripherals / between devices)	**4**

Question	Answer	Marks
8(a)	2 marks for SSL, 2 marks for Firewall **SSL protocol** **Two** from: • uses encryption • encryption is asymmetric / symmetric / both • makes use of (public and private) keys • data is meaningless (without decryption key / if intercepted) **Firewall** **Two** from: • helps prevent unauthorised access // helps prevent hacking • checks that data meets criteria // identifies when data does not meet criteria • acts as a filter for (incoming and outgoing) data // blocks any unacceptable data //allows acceptable data through	**4**

QUESTION 3.

Question	Answer	Marks
7	Compiler Any **three** from: – Translates high-level language into **machine code/low level language** – Translates (the source code) all in one go/all at once – Produces an executable file – Produces an error report Interpreter Any **three** from: – Translates high-level language into **machine code/low level language** – Translates (the source code) line by line/statement by statement – Stops if it finds an error – Will only continue when error is fixed	**6**

Question	Answer	Marks
8(a)	Any **four** from: – Shines light / (red) laser at barcode – Light is called an illuminator – Light is reflected back // White lines reflect light // Black lines reflect less light/absorbs light – Sensors / photoelectric cells detect the light – Different reflections / bars will give different binary values / digital values // pattern converted to digital values – A microprocessor interprets the data	**4**
8(b)	Any **three** from: – barcode identifies a (unique) product – barcode can be used to look up product (in a database) – data about stock levels can be stored on a system – stock can be automatically deducted from the system – can check stock is below a certain level // check stock level – automatic re-order // Alerts when stock is low – automatically update new stock level – to locate if an item of stock is available in another location	**3**

Question	Answer	Marks
8(c)	Any **four** from: – (Infrared) rays are sent across screen (from the edges) – Has sensors around edge // Sensors capture beams – (Infrared) rays form a grid across the screen – (Infrared) ray is broken (by a finger blocking a beam) – **Calculation** is made (on where beam is broken) to locate the 'touch' // Co-ordinates are used to locate the touch	**4**
8(d)	Secondary Storage – any **two** from: – Not directly accessed by the CPU – Non-volatile storage – Secondary is internal to the computer/device – An example of secondary storage would be HDD/SSD Off-line storage – any **two** from: – Non-volatile storage – Off-line storage is storage that is removable from a computer/device // not internal // portable – An example of off-line storage would be CD/DVD/USB stick/SD card/magnetic tape/ external HDD/SSD	**4**

Question	Answer	Marks
9	Any **six** from: – Suitable biometric device, such as fingerprint scanner/retina/eye/iris scanner/face recognition/voice recognition/palm scanner // description of use e.g. use fingerprint on device – Sensor (in biometric device) captures/takes data/readings (of user) – Data/readings are converted from analogue to **digital** (using ADC) – Data/reading sent to the microprocessor – Data/readings compared to stored values/data … – … if data/readings **match** user can enter – … if data/readings **do not match** user is declined entry // user asked to try again … – … alert may be sent to security // alarm may sound	**6**

Question	Answer	Marks
8(c)(i)	Any **two** from: – Paper jam – Out of paper – Out of toner/ink – Buffer full – Awaiting input – Print complete – Printer ready Award any other valid example	**2**
8(c)(ii)	Any **one** from: – Operating system – Interrupt handler – Interrupt service routine	**1**

Question	Answer	Marks
9(a)		**6**

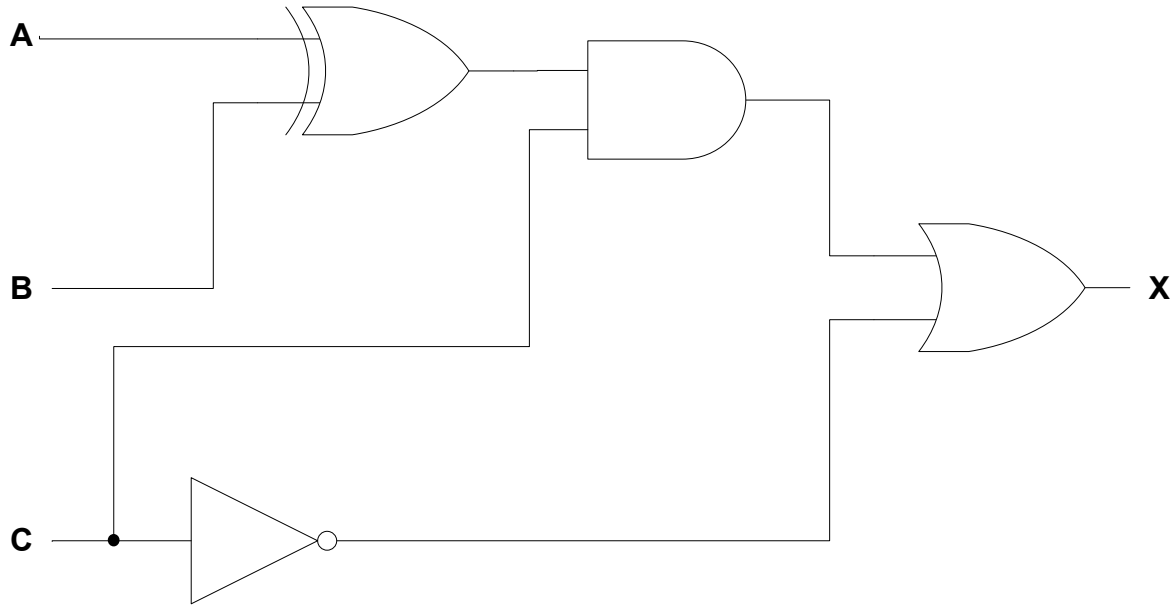
Statement	**HDD (✓)**	**SSD (✓)**
It has a limited number of read/write cycles		✓
It uses magnetic properties to store data	✓	
It has moving parts	✓	
It is non-volatile storage	✓	✓
It can be used as an external storage device to back-up data	✓	✓
It uses flash memory to store data		✓

Question	Answer	Marks
9(b)	Any **two** from: – CD (drive) – DVD (drive) – Blu-ray (drive)	**2**

Question	Answer	Marks
10(a)	**One** mark for similarity, **two** marks for differences Similarity: – Both are designed to steal personal data – They both pose as a real company/person Differences: – Pharming uses malicious code installed on hard drive – Phishing is in form of an email – Phishing requires use to follow a link / open an attachment	**3**
10(b)	– Virus – Malware	**2**
10(c)(i)	– Incorrect	**1**
10(c)(ii)	Any **four** from: – Can help prevent hacking – Can monitor incoming and outgoing traffic – Can set criteria / rules are set for traffic – Can check whether traffic meets / defies criteria rules – Can rejects any traffic that does not meet / defies criteria	**4**

QUESTION 5.

Question	Answer	Marks
5(a)	Any **four** from: – Stock control system has a database of stock – Each product has a (unique) barcode – Barcode is scanned, and product looked up in database – Stock levels for product are reduced (by 1) – Stock is checked against minimum level – If stock at/below minimum level an order is placed – When stock is re-ordered flag is reset	**4**
5(b)	– It has RAM to store the data / programs / by example **currently in use** – It has ROM to permanently store the boot up instructions – It has HDD to store the stock database / software / OS / by example	**3**
5(c)	Any **four** from: – MAR – MDR – PC – ALU – CU – ACC – CIR – Buses – Registers	**4**

Question	Answer	Marks
6(a)	 One mark for each correct gate.	4

1 (a) 1 mark for each name of application + 1 mark for description of use

Hardware item	Application and how the hardware item is used
Barcode reader	Supermarket checkout – read barcodes to find prices, description – allows automatic stock control Library system – can track books on loan – can link books to borrowers using barcoded cards Airport checkouts – barcodes on luggage to track whereabouts
Microphone	Voice recognition system – allows computer to recognise spoken words and use them as input to, e.g., a word processor Multimedia presentations – allows voice-overs on presentations Video conferencing/VoIP – allows users to speak to each other
Touch screen	Mobile telephone/tablet – allows user to select apps/icons – easy method to input data Ticket/information kiosk – limits the options available for ease of use
Infrared sensor	Burglar/intruder detection system – detects presence of a person by breaking beam/change of temperature Automatic doors – breaking i/r beam allows detection of person approaching door Counting, e.g. people/cars – every time beam is broken it can automatically send data and allow automatic counting

[8]

(b) Any **two** from:
- Blu-ray discs use blue/violet lasers rather than red lasers as used by DVDs
- storage capacity of Blu-ray discs is much higher than standard DVDs
- Blu-ray discs use one polycarbonate layer; DVDs use two layers
- Blu-ray discs have a built-in secure encryption system

[2]

(c) Any **two** from:
- DVD has one spiral track; DVD-RAM has several concentric tracks
- DVD-RAM can be written to and read from at the same time; DVD-R only allows the read operation to occur
- DVD-R only allows data to be read (can't write to it) whereas DVD-RAM allows reading and writing operation

[2]

2 **(a)** 1 0 1 1 0 1 0 1

F 6 [2]

(b) Any **two** from:
- HTML
- MAC address
- used in assembly language/machine code
- debugging (displays bytes in hex when using memory dumps)

[2]

(c)
- Can represent 16 bit words as only 4 hexadecimal digits
- It is easy to convert hex digits back to binary if necessary [2]

(c) Register Z

(d) **(i)** (byte) 5

(ii) (column) 4 [1]

(iii) corrected byte is: **1 0 0 1 1 1 1 1** [1]

(iv) that gives the value: **1 5 9**
(follow through applies) [1]

(v) Any **two** from:

– The byte would be transmitted without having 5 consecutive 1's
– The fault condition would not be recognised [2]

6 Any **two** from:

High level language

– easier/faster to write code as uses English-like statements
– easier to modify as uses English-like statements
– easier to debug as uses English-like statements
– portable language code

Any **two** from:

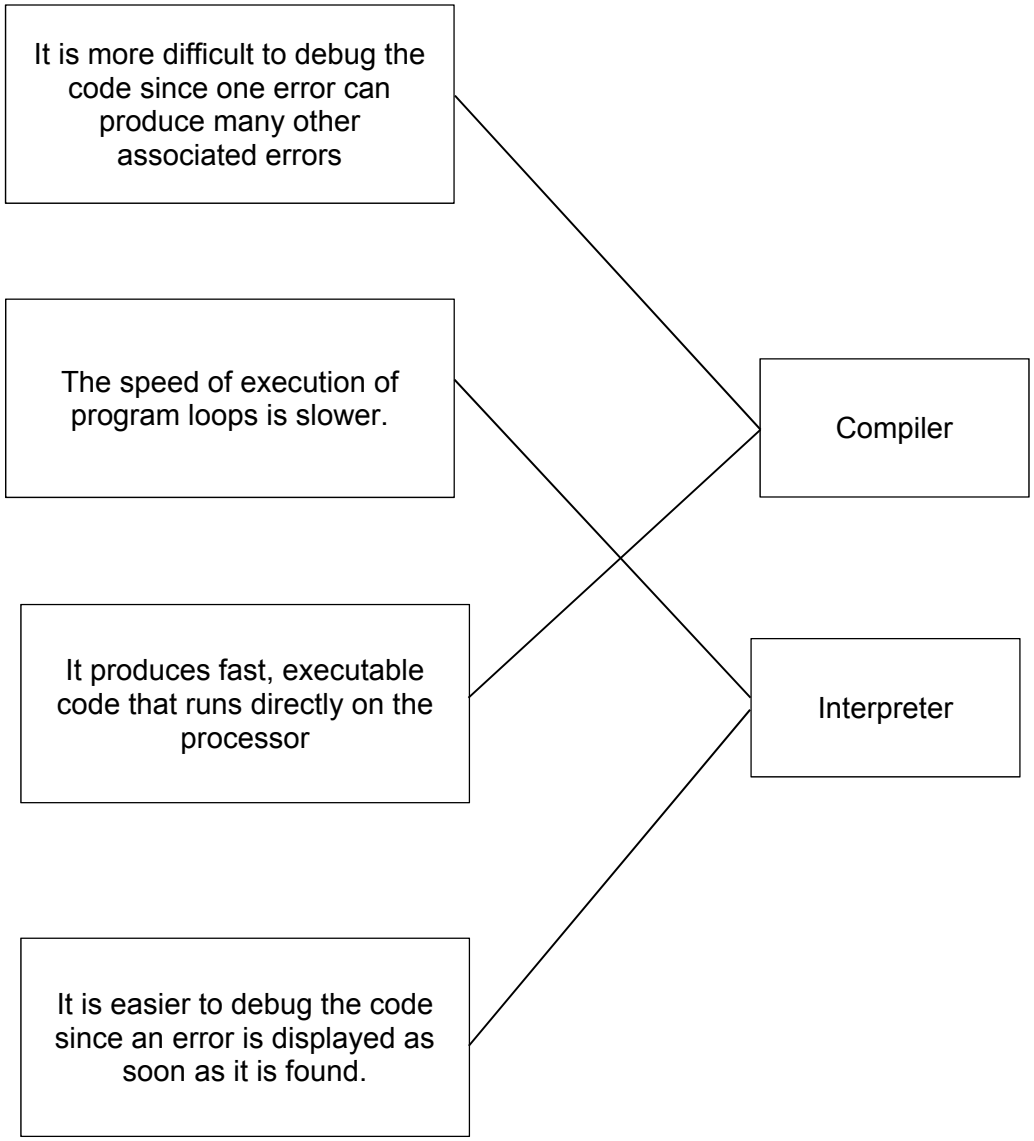
Low level language

– can work directly on memory locations
– can be executed faster
– translated program requires less memory [4]

7 Any **four** from:

– reaches maximum brightness quickly
– colours are vivid
– good colour definition/contrast can be achieved
– screens can be thinner/thin
– more reliable as LED's are long lasting
– consume very little/less energy [4]

8


It is more difficult to debug the code since one error can produce many other associated errors
The speed of execution of program loops is slower.
It produces fast, executable code that runs directly on the processor
It is easier to debug the code since an error is displayed as soon as it is found.
Compiler
Interpreter

[4]

9 Any **six** from:

– infrared / motion / pressure (sensor) // sensor detects movement/pressure
– signals/data sent (continuously) to microprocessor
– converted from analogue to digital (using ADC)
– microprocessor compares value with those stored in memory
– if sensor value does not match the stored value(s) …
– … signal sent to switch on the light
– … signal sent to keep the light on
– … light remains on for a period of time (30 seconds)
– if sensor value matches the stored value(s) …
– … light will remain off
– … will turn off after period of time (30 seconds)
– works in a continues loop [6]

10 (a) (i) 2 marks for 3 correct binary conversions, 1 mark for 2 correct binary conversions [2]

0	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**1**

(ii) 1 mark for each correct hex value converted

1 A F [3]

(b) 2 marks for working + 1 mark for correct answer

Working
– $1200 \times 8 = 9600$ (bytes)
– 9600/1024 or 9600/1000

Answer
– 9.4 or 9.6 kilobytes [3]

(c) Any **one** from:

MAC address

– Media Access Control (address)
– unique number that identifies a device (connected to the Internet)
– address is made up of manufacturer id + serial number of device
– address is allocated by the manufacturer

Any **one** from:

IP address

– Internet Protocol (address)
– location/address of a device on the Internet
– address is unique for given Internet session
– address is supplied when a device connects to the Internet
– address is allocated by the network [2]

8

Statement	TRUE or FALSE
MIDI stores the actual music notes in a compressed format	**FALSE**
JPEG files are examples of lossless file compression	**FALSE**
MP3 files are, on average, 90% smaller than the music files stored on a CD	**TRUE**
MP4 files are examples of lossy file compression	**TRUE**

[4]

9 **(a)** Any **two** from:

- a large number of requests are sent to the network/server all at once
- designed to flood a network/server with useless traffic/requests
- the network/server will come to a halt/stop trying to deal with all the traffic/requests
- prevents users from gaining access to a website/server

[2]

(b) 1 mark for each security threat and 1 mark for matching description

Security threat	Description
Viruses	– software that replicates – causes loss/corruption of data // computer may "crash"/run slow
Hacking/cracking	– illegal/ unauthorised access to a system/data
Phishing	– a link/attachment sends user to fake website (where personal data may be obtained)
Pharming	– malicious code installed on user's hard drive / computer – user is redirected to a fake website (where personal data may be obtained)
Spyware/key logger	– send/relay key strokes to a third party

[4]

QUESTION 9.

Question	Answer	Marks
9(a)	Any **four** from: – (Red) laser is used – (Laser beams) shines onto surface of the disk – It is rotated (at a constant speed) to be read – Surface is covered in a track (that spirals from the centre) – Data is represented on the surface using pits and lands – Pits and lands represent binary values – Pits reflect light back differently (to the area in between/land) – Optical device can determine the binary value from the light reflection	**4**
9(b)	1 mark for calculation, 1 mark for correct answer: – 1000 × 16 – 16000/8 – Answer is **2000** bytes	**2**
9(c)	**Four** from: (Max 2 for either primary or secondary) – Primary RAM and ROM – Secondary HDD and SSD – Primary is directly accessible by CPU – Secondary is not directly accessible by CPU – Primary is internal to computer – Secondary can be internal **or** external to the computer – Primary stores boot up instructions **and** can hold data whilst being processed – Secondary stores files/software – Primary has faster access speed – Secondary has a slower access speed – Primary has both volatile **and** non-volatile – Secondary is non-volatile	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>10</td><td>1 mark for each correct tick

<table>
<tr><th>Statement</th><th>true (✓)</th><th>false (✓)</th></tr>
<tr><td>Assembly language uses mnemonic codes.</td><td>✓</td><td></td></tr>
<tr><td>Assembly language programs do not need a translator to be executed.</td><td></td><td>✓</td></tr>
<tr><td>Assembly language is a low-level programming language.</td><td>✓</td><td></td></tr>
<tr><td>Assembly language is specific to the computer hardware.</td><td>✓</td><td></td></tr>
<tr><td>Assembly language is machine code.</td><td></td><td>✓</td></tr>
<tr><td>Assembly language is often used to create drivers for hardware.</td><td>✓</td><td></td></tr>
</table>
</td><td>6</td></tr>
</table>

QUESTION 10.

Question	Answer	Marks
8(a)	1 mark for correct calculation method, 1 mark for correct answer: • 2048/1024 (or 1024 × 2) • 2 GB	**2**
8(b)	• Instructions/programs/data • … currently in use	**2**
8(c)	Any **three** from: • RAM is volatile, ROM is non-volatile • RAM is temporary, ROM is (semi) permanent • RAM normally has a larger capacity than ROM • RAM can be edited ROM cannot be edited // Data can be read from and written to RAM, ROM can only be read from.	**3**

Question	Answer	Marks
9(a)	• It is an input device • It measures/takes (physical) readings of the surrounding environment / environment by example / physical properties	**2**
9(b)	1 mark for each sensor, 2 marks for each description: Moisture (sensor) • To measure the water content of the soil • To alert when the soil is too dry or too wet/needs watering pH (sensor) • To measure how acidic/alkaline the soil is • To alert when there may be something polluting the soil Light (sensor) • To measure the brightness of the environment • To alert when the fruit has too little/too much light Temperature (sensor) • To measure the temperature of the environment • To alert when it is too hot/too cold for the fruit to grow Gas (sensor) • To measure the amount of CO2/oxygen present • To alert when too much CO2/oxygen present Humidity (sensor) • To measure the water content in the air • To alert when the air is too dry Infra-red / motion (sensor) • To measure level of infra-red/microwaves deflected • To alert to any intruders e.g. animals stealing the fruit	**6**

QUESTION 11.

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>1 mark for the correct tick for each storage
<table>
<tr><th>Storage device or media</th><th>Primary (✓)</th><th>Secondary (✓)</th><th>Off-line (✓)</th></tr>
<tr><td>External HDD</td><td></td><td></td><td>✓</td></tr>
<tr><td>RAM</td><td>✓</td><td></td><td></td></tr>
<tr><td>Internal SSD</td><td></td><td>✓</td><td></td></tr>
<tr><td>ROM</td><td>✓</td><td></td><td></td></tr>
<tr><td>DVD</td><td></td><td></td><td>✓</td></tr>
</table></td><td>5</td></tr>
<tr><td>5(b)</td><td>Four from:
• The disc is rotated/spun
• Laser beam is used
• The laser beam makes indentations on the surface of the disc/pits and lands
• The data is written in a spiral/concentric tracks
• The pits and lands represent binary values/1s and 0s
• It is called burning data to the disc</td><td>4</td></tr>
<tr><td>5(c)(i)</td><td>Solid state</td><td>1</td></tr>
<tr><td>5(c)(ii)</td><td>Two from:
• It has no moving parts so will be durable
• It is small/compact so it can be easily fit onto the device
• It is light so it will not be difficult to lift for the drone
• It can hold the large amount of data needed for the video/film footage
• Uses less power so drone battery will last longer</td><td>2</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>6(a)</td><td>1 mark for the correct ticks (✓) for each statement

<table>
<tr><th>Statement</th><th>3D printer (✓)</th><th>3D cutter (✓)</th></tr>
<tr><td>Outputs a physical 3D product</td><td>✓</td><td>✓</td></tr>
<tr><td>Uses a high powered laser to create the output</td><td></td><td>✓</td></tr>
<tr><td>Creates 3D prototypes</td><td>✓</td><td>✓</td></tr>
<tr><td>Uses layers of material to create the output</td><td>✓</td><td></td></tr>
</table>
</td><td>4</td></tr>
<tr><td>6(b)</td><td>Computer Aided Design/CAD</td><td>1</td></tr>
<tr><td>6(c)</td><td>Three from:
• Uses a large number of tiny mirrors
• Mirrors are laid out in a grid/matrix
• Each mirror creates a pixel in the image
• Mirrors can tilt toward or away from light source
• The mirrors reflect light toward a (projection) lens
• Colour is produced using a colour wheel // Light passes through colour wheel // filters light into red/green/blue
• Can be used to display an image on a wall/screen</td><td>3</td></tr>
</table>

Question	Answer	Marks
4(a)	**One** from: • Touch screen • Keyboard • Microphone • Mouse	**1**
4(b)	**One** from: • Headphones • Speakers • Printer • Light / LED	**1**
4(c)	**One** from: • HDD • SSD • USB drive	**1**
4(d)	**Four** from: • QR code is scanned using a camera on a mobile device … • … and read / decoded using an application / software • Illuminator shone on code • Squares reflect light differently • Corners of code are used for orientation • Opens document with information // Directs to website with information • QR code can be saved for future reference	**4**

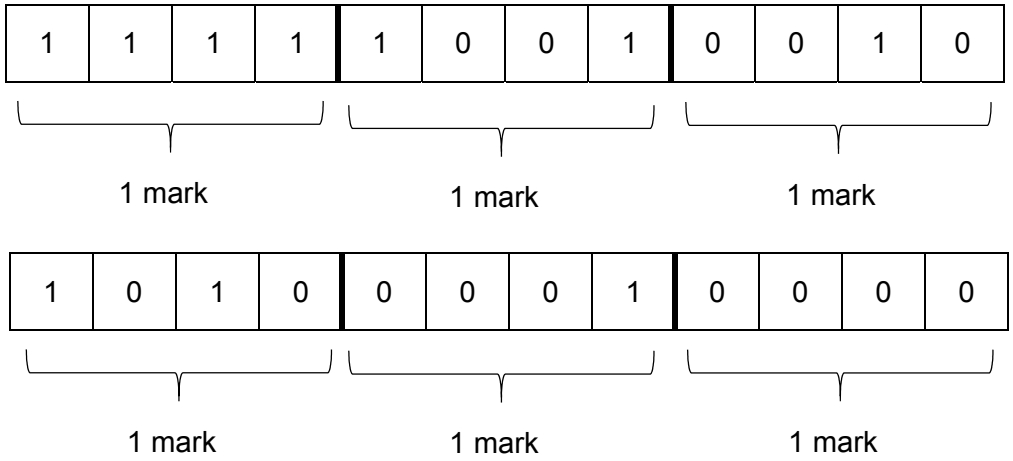
Question	Answer	Marks
5(a)	• Data is sent down a single wire … • … one bit at a time • Data is sent in both directions … • … but only one direction at a time	**4**
5(b)	**One** mark for correct byte (Byte) 2 // 01010100 **Three** from: • Added up / counted the 1s / 0s • Even parity used // 3 bytes are even • Byte 2 uses odd parity // 1 byte is odd	**4**

QUESTION 13.

Question	Answer	Marks
11(a)	**RAM** • To store the data / instructions / parts of OS that are currently in use **ROM** • To store the firmware / bootup instructions / BIOS **SSD** • To store files / software // by example	**3**
11(b)	**Two** from: • It is more durable // it has no moving parts • It has a faster read / write / access speed • It is more compact / light weight / smaller / portable • It uses less energy // battery will last longer • It is quieter • Not affected by magnetic forces • It runs at a cooler temperature • Less latency // takes less time to warm up	**2**

QUESTION 14.

Question	Answer	Marks
1(a)(i)	**Two** from: • 2D scanner • Touchscreen • Keypad/keyboard • Card reader • Mouse • Digital camera	**2**
1(a)(ii)	**Two** from: • HDD • SSD • USB flash memory drive • SD card • Any optical	**2**
1(a)(iii)	**Two** from: • Monitor/Touch screen • Speaker • Printer • LED // Light	**2**
1(b)(i)	• Increase the length of the key // make key 12-bit, etc.	**1**
1(b)(ii)	• Cypher text	**1**

Question	Answer	Marks
1(b)(iii)	**Six** from: • The system could use odd or even parity • A parity bit is added • The data is checked to see if it has incorrect/correct parity // by example • If parity is correct no error is found • An acknowledgement is sent that data is received correctly • The next packet of data is transmitted • If incorrect parity is found an error has occurred • A signal is sent back to request the data is resent • The data is resent until data is received correctly/timeout occurs	**6**
1(c)(i)		**6**

Question	Answer	Marks
1(c)(ii)	**One** mark for identification: • Compression **Three** from e.g.: • Best compression would be lossy • Use compression algorithm • This would remove all the unnecessary data from the file // removes detail/sound that the human eye/ear may not see/hear • Reduce colour palette … • … so each pixel requires fewer bits • Reduce resolution • Only store what changes between frames // temporal redundancy	**4**
1(d)	**Five** from: • The display is made up of pixels … • … that are arranged together as a matrix • Each pixel has three filters, red, blue and green • Shades of colour are achieved by mixing red, blue and green • The screen is backlit • Light is shone through the liquid crystals • The liquid crystals can be made to turn solid or transparent/on or off … • … by changing the shape of the crystal	**5**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>One mark for each correct row
<table>
<tr><th>Statement</th><th>True (✓)</th><th>False (✓)</th></tr>
<tr><td>High-level languages need to be translated into machine code to run on a computer</td><td>✓</td><td></td></tr>
<tr><td>High-level languages are written using mnemonic codes</td><td></td><td>✓</td></tr>
<tr><td>High-level languages are specific to the computer’s hardware</td><td></td><td>✓</td></tr>
<tr><td>High-level languages are portable languages</td><td>✓</td><td></td></tr>
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