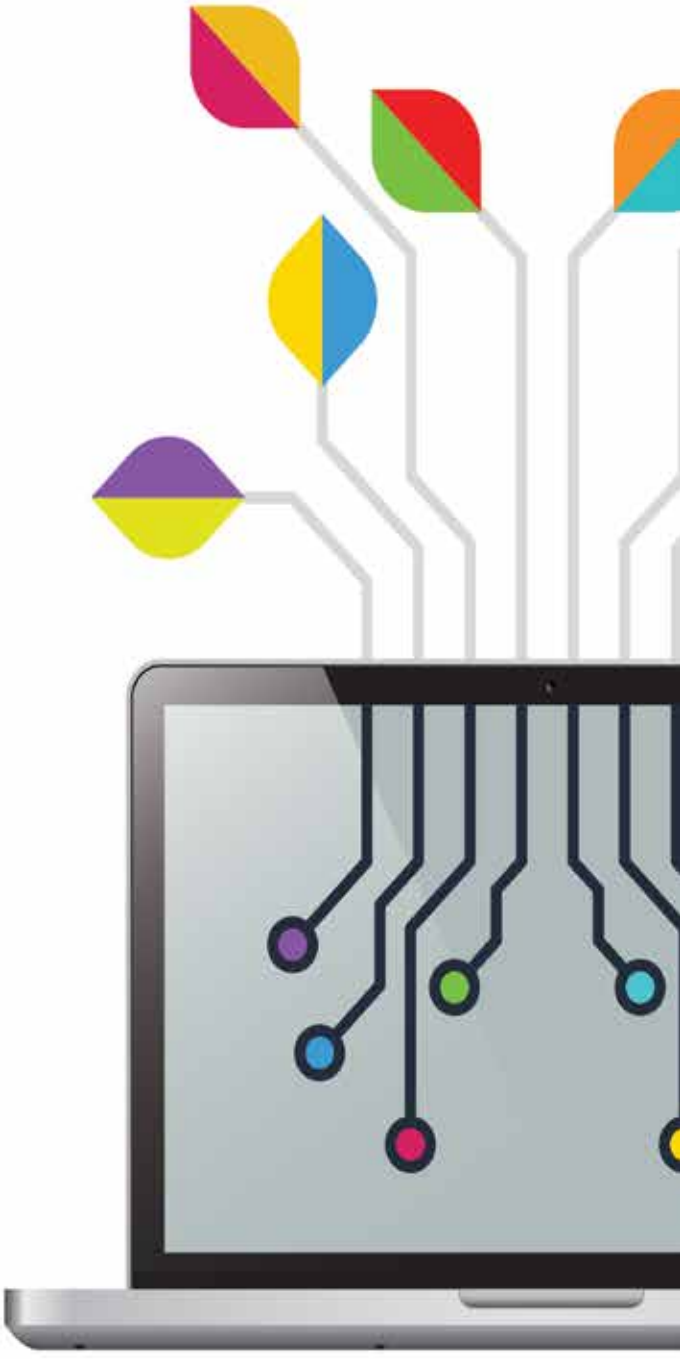
BTEC

Pearson BTEC Level 3 National in Computing

Unit 2: Fundamentals of Computer Systems



Sample Assessment Materials (SAMs)

For use with Extended Certificate, Foundation Diploma and Extended Diploma in Computing

First teaching from September 2016 **Issue 1**

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BTEC

Pearson BTEC Level 3 Nationals

Write your name here

Surname	**Forename**

Learner Registration Number | **Centre Number** | **Level 3**

Computing

Unit 2: Fundamentals of Computer Systems

Extended Certificate/Foundation Diploma/Extended Diploma in Computing

Sample assessment material for first teaching September 2016

Time: 1 hour 45 minutes

You do not need any other materials.

Total marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in grey boxes – *use this as a guide as to how much time to spend on each question.*
- You may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Paper reference
XXXX/XX
S50697A

S 5 0 6 9 7 A 0 1 1 8

Turn over ▶

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1 Jasmine owns a medium-sized business. Her staff use tablet devices and desktop PCs to connect to the office network.

(a) State **two** types of communication channel that would be used when synchronising data between a tablet device and the office network.

2 marks

1 .....

2 .....

(b) Explain **two** business benefits of synchronising data between the tablet devices and the office network.

4 marks

1 .....

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2 .....

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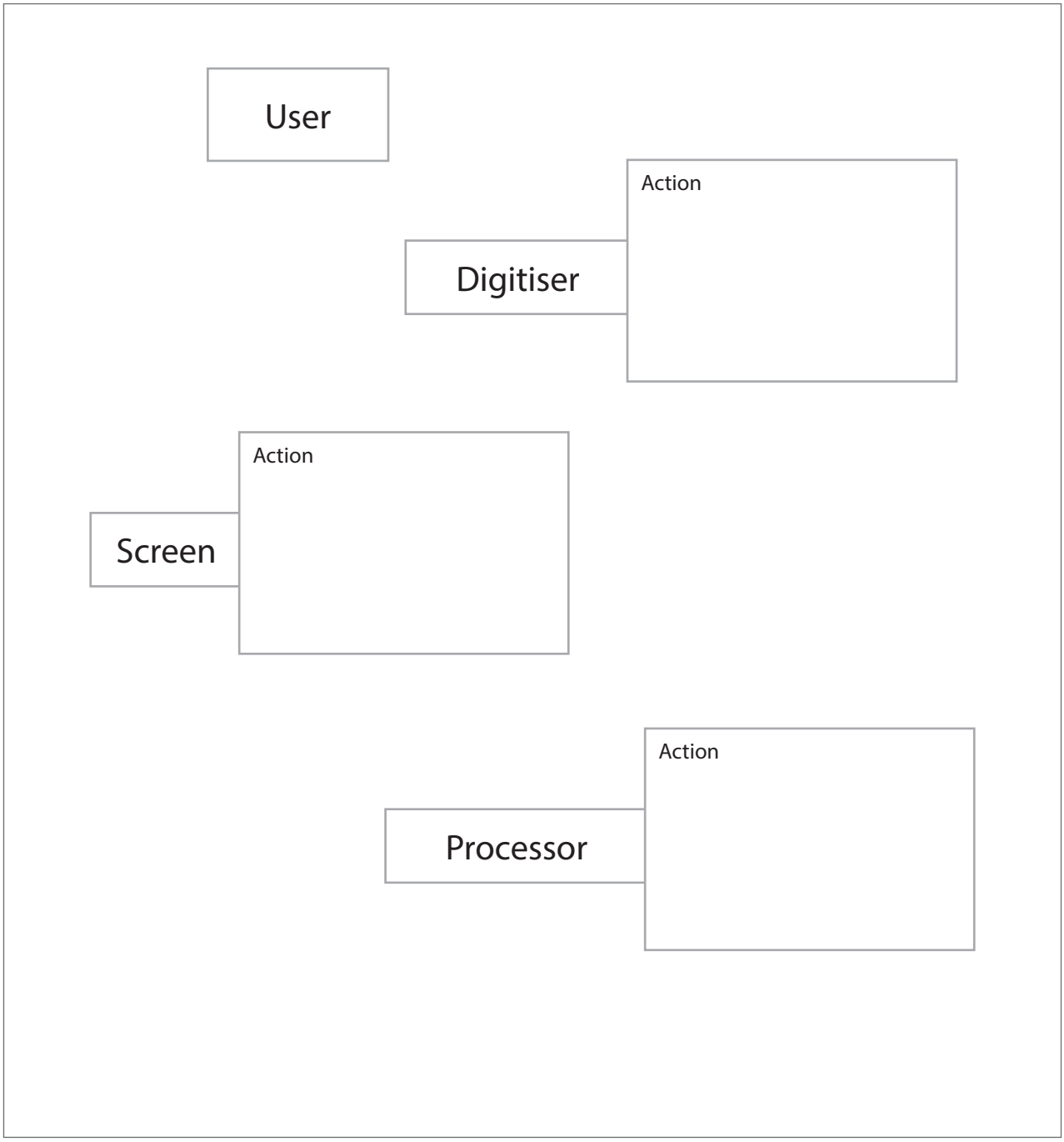
When a touch screen is used, data is exchanged and processed by three main components (digitiser, processor and screen).

(c) Complete the diagram to show the action performed by each component, and the order and direction in which data is exchanged.

4 marks



Tablet devices use solid state drives (SSDs) rather than hard disk drives (HDDs).

(d) Explain why SSDs do not require defragmentation.

2 marks

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(e) Analyse how the features of SSDs make them more suitable for use in tablet devices than HDDs.

6 marks

Total for Question 1 = 18 marks

2 Leroy's company employs a small number of staff. He manages the company's computer systems.

Desktop PCs are connected to the office network. Each desktop PC is loaded with programs and staff files are stored on the office server.

Leroy intends to upgrade the hard drives in the desktop PCs. Table 1 shows the specifications for the hard drives he is considering.

Feature	Hard drive 1	Hard drive 2	Hard drive 3
Capacity	1 TB	500 GB	500 GB
Disk cache	64 MB	32 MB	8 MB
Spindle speed	7200 rpm	5400 rpm	5400 rpm
Size	3.5 inch	3.5 inch	2.5 inch
Weight	400 g	450 g	107 g

Table 1

Disk cache is used to queue commands to be sent to the processor.

(a) Identify **one** other role of disk cache.

1 mark

.....

.....

Leroy considers the capacity of the hard drives when deciding which one to choose.

(b) Explain **one** way the capacity of the hard drives would affect Leroy's choice.

2 marks

Leroy chooses hard drive 1 for use in the network server.

(c) Explain **one** way the higher spindle speed would impact on Leroy's staff.

2 marks

The network storage system uses RAID 1.

(d) Describe how RAID 1 can be used to improve a computer system's reliability.

3 marks

Leroy installs an operating system on a desktop PC.
One component of the operating system's kernel is the device drivers.
A device driver is used by the operating system to interact with hardware.

(e) Give **two** ways the device driver performs this function.

2 marks

1

2

Text can be encrypted using a Caesar cipher (substitution cipher).

Table 2 shows the starting letter and binary encryption key for a Caesar cipher.

Starting letter	Binary encryption key
G	00010001

Table 2

(f) Calculate the resulting encrypted letter using the given starting letter and encryption key.

You are advised to show your working.

3 marks

Answer: .....

(g) Explain **one** drawback of using a Caesar cipher to encrypt text.

2 marks

.....

.....

.....

.....

Total for Question 2 = 15 marks

3 Computers transmit data using different connections and protocols.

(a) Give **one** reason why computer systems use protocols when transmitting data.

1 mark

Files may be compressed before they are transmitted.

(b) Explain **two** disadvantages of receiving files that have been sent in compressed format.

4 marks

1

2

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Packet data is used to transmit data over wide area networks.
Packet data contains a payload.

(c) Analyse how the other components of the structure of the data packet aid the transmission and delivery of the payload.

8 marks

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A primary school's network is used by administrators, teachers and pupils.
The network is accessed by desktop PCs and laptop computers.
The school is installing a new open source operating system on all of its computers.

(d) Evaluate the school's decision to use an open source operating system instead of a proprietary operating system.

12 marks

Total for Question 3 = 25 marks

4 Programmers can use arrays to store data.
Data from an array is allocated to computer memory.

(a) Explain **one** way memory allocation affects how an array is handled in a computer system.

2 marks

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Figure 1 shows part of the internal architecture of a CPU (Central Processing Unit).

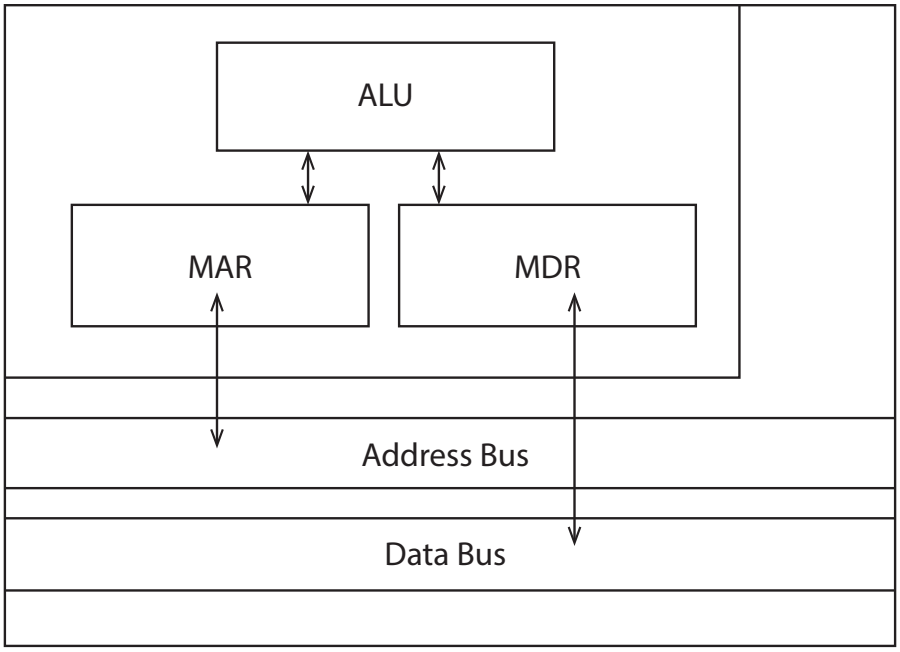

Figure 1

During the fetch-execute cycle, the ALU (Arithmetic Logic Unit) uses the MDR (Memory Data Register) and the MAR (Memory Address Register).

(b) Describe the roles of MDR and MAR during the fetch-execute cycle when reading and writing data to and from the main memory.

4 marks

Saira designs a multi-processor computer system to support a large company's computing requirements.

She uses NUMA (Non-Uniform Memory Access) rather than UMA (Uniform Memory Access).

(c) Explain **two** benefits of using NUMA in a computer system.

4 marks

A graphic designer uses computer systems to store and manipulate digital images for use in printed and digital products.

The images used in the designs are acquired from a range of sources, including mobile phones and the web. They are also created using graphics software.

The graphic designer uses different bitmap file formats and vector images.

(d) Analyse the impact that digital image representation has on the way images are viewed, stored and used.

12 marks

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Total for Question 4 = 22 marks

END OF EXAM

TOTAL FOR PAPER = 80 MARKS

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Unit 2: Fundamentals of Computer Systems – sample mark scheme

General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the mark scheme, not according to their perception of where the grade boundaries may lie.
- All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the learner's response is not worthy of credit, according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a learner's response, the team leader must be consulted.
- Crossed-out work should be marked UNLESS the learner has replaced it with an alternative response.

Specific marking guidance for levels-based mark schemes*

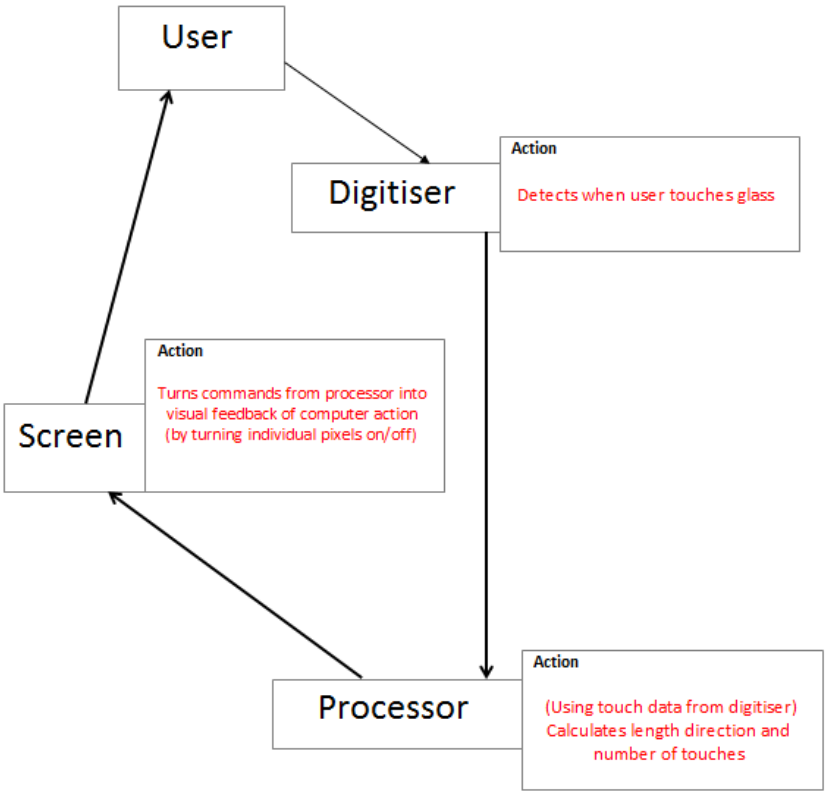
Levels-based mark schemes (LBMS) have been designed to assess learner work holistically. They consist of two parts: indicative content, and levels based descriptors. Indicative content reflects specific content-related points that a learner might make. Levels-based descriptors articulate the skills that a learner is likely to demonstrate, in relation to the assessment outcomes being targeted by the question. Different rows in the levels, represent the progression of these skills.

When using a levels-based mark scheme, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer in response to the assessment focus/objective and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band depending on how they have evidenced each of the descriptor bullet points.

Question number	Answer	Mark
1(a)	Award **1** mark for any of the following up to a maximum of **2** marks: • half-duplex • full-duplex • point-to-point.	**(2)**

Question number	Answer	Mark
1(b)	Award **1** mark for identification and **1** mark for appropriate expansion, up to a maximum of **4** marks. • Ensures version control (1), so employees will always be working from the most up-to-date version of a file (1). • Centrally stored data/all data will be stored on the server (1), making back-up and recovery easier (1). • Improved productivity (1), as staff can access files from different devices to suit their location/preferred ways of working (1). • Improved customer support (1) as more than one member of staff could access specific files/information to assist customers (1). Accept any other relevant phrasing/wording.	**(4)**

Question number	Answer	Mark
1(c)		
	Award **1** mark for inclusion of each of the following in the diagram, up to a maximum of **4** marks. • Digitiser Action = detects when user touches glass • Processor Action = (using touch data from digitiser) calculates length direction and number of touches • Screen Action = turns commands from processor into visual feedback of computer action (by turning individual pixels on/off) • correct order of data flow (User – Digitiser – Processor – Screen – User). Accept any other relevant phrasing/wording. Additional guidance: To gain 'correct order' mark, all connections must be identified in the given order.	**(4)**

Question number	Answer	Mark
1(d)	Award **1** mark for identification and **1** mark for appropriate expansion. Award a maximum of **2** marks. Read write speeds are the same across the entire volume (1), so data does not need to be sequential (for optimum access speeds) (1). Accept any other relevant phrasing/wording.	**(2)**

Question number	Indicative content
1(e)	Answers will be credited according to the learners' demonstration of knowledge and understanding of the material, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some/all of the indicative content but should be rewarded for other relevant answers. **Size** • Does not use 'disks', write heads etc. so can be manufactured to smaller sizes. • Smaller form factor allows them to be incorporated in to smaller form factor of devices. • (Smaller size) provides more space in a mobile device for other components that will improve the ways the device can be used (GPS sensor, camera/image sensor, larger battery). **Moving parts/flash storage** • No disks and write heads, reduce the overall weight of the device making it more portable. • No mechanical operation, which reduces noise and heat generation. **Shock proof** • Data is written electronically, so data can be accessed while the device is being moved, without risk of interruption or corruption. • No mechanical parts means the data on the drive will not be corrupted if the device is dropped, which is more likely in a hand held device than a desktop computer. **Cooling** • Generates very little heat compared to traditional HDD so device does not require additional cooling methods, which allows for smaller and lighter devices. **Power consumption** • Uses less power than traditional HDD as read/write operations do not require the system to run motors to drive HDD spindles, read heads.

Mark scheme (award up to 6 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.		
Level	**Mark**	**Descriptor**
Level 0	0	No rewardable material.
Level 1	1–2	Technical vocabulary is used but it is not used appropriately to support arguments, in relation to the issues of the question. Issues are identified but chains of reasoning are not made, leading to a superficial understanding of the relative importance of issues to the scenario.
Level 2	3–4	Accurate technical vocabulary is used to support arguments but not all are relevant to the issues of the question. There is consideration of relevant issues using logical chains of reasoning but it does not reflect on their relative importance to the given scenario.
Level 3	5–6	Fluent and accurate technical vocabulary is used to support arguments that are relevant to the issues of the question. There is a balanced and wide-ranging consideration of relevant issues, using coherent and logical chains of reasoning that show a full awareness of their relative importance to the given scenario.

Question number	**Answer**	**Mark**
2(a)	Award **1** mark for any of the following: • read ahead/read behind • speed matching • write acceleration. Additional guidance: Do not accept command queuing.	**(1)**

Question number	Answer	Mark
2(b)	Award **1** mark for identification and **1** mark for appropriate expansion. • The hard drives will only be used for programs and operating systems (1), therefore all three specifications should provide enough storage (1). • The company may need to add additional software in the future (1), therefore the larger capacity hard drive may be used to avoid having to upgrade again in the future (1). • Hard drives perform more quickly when they are less full (1), so a larger capacity hard drive may be chosen so more of the drive capacity is kept free (1). Accept any other relevant phrasing/wording. Additional guidance: Do not accept answers relating to storing user files.	**(2)**

Question number	Answer	Mark
2(c)	Award **1** mark for identification and **1** mark for appropriate expansion. • Higher speed improves access time (by the server) (1), so data retrieval time is lower (for staff) (1). • Server can locate data more quickly (1), reducing wait time when more than one person is accessing the drive (1). Accept any other relevant phrasing/wording. Additional guidance: Reference to speed must be about data access and load times.	**(2)**

Question number	Answer	Mark
2(d)	Award **1** mark for each related descriptive point up to a maximum of **3** marks. • RAID systems use additional disk drives to add data redundancy to the system (1). • RAID1 'mirrors' data/creates an identical copy of the data on another disk (1). • If the primary disk fails, the system can run off the 'redundant' disk (1). Accept any other relevant phrasing/wording. Additional guidance: The points are interchangeable and not hierarchical, and may appear in any order in the response.	**(3)**

Question number	Answer	Mark
2(e)	Award **1** mark for any of the following up to a maximum of **2** marks: • provides a 'translation' between the computer software and the hardware • provides the commands that control the hardware • communicates with the device directly using the 'bus'/communication system • provides the interrupt handling. Accept any other relevant phrasing/wording.	**(2)**

Question number	Answer	Mark
2(f)	Award **3** marks for correct answer only. Award **1** mark for stage 1 correct answer only. Award **1** mark for method 'G' + stage 1 answer only. • Stage 1 answer: 00010001 = 17 • Shows the following method: letter 'G' is substituted with the letter 17 places further through the alphabet • Final answer: letter 'X' Additional guidance: Allow follow through for incorrect answer at stage 1.	**(3)**

Question number	Answer	Mark
2(g)	Award **1** mark for identification and **1** additional mark for appropriate expansion. • Creates a relatively small number of possible permutations (1), so can be easily broken with 'brute force' attacks (1). • Some letters naturally occur in messages more frequently (1), so the key can be easily worked out (by analysing which letters appear more often in the encrypted message) (1). Accept any other relevant phrasing/wording.	**(2)**

Question number	Answer	Mark
3(a)	Award **1** mark for any of the following: • establishes the rules as to how a piece of data is transmitted • identifies the type of information being sent (by the protocol being used) • ensures that the data is correctly handled/forwarded at all stages of transmission. Accept any other relevant phrasing/wording.	**(1)**

Question number	Answer	Mark
3(b)	Award **1** mark for identification and **1** mark for appropriate expansion, up to a maximum of **2** marks each. • Compression type might not be compatible with target system (1), meaning files may need to be resent/requested again in a different format (1). • Compression may increase the size of some file formats (1), which could slow the speed at which it is received/ transferred (1). • Anti-virus/malware software may perceive a compressed file as a threat (1) and might block access to the file (1). • Additional processor time must be used by the target system to extract/decompress the file (1), which may be problematic if using a low specification computer (1). • Decompressing the file adds additional memory load on the target system (1), which may cause the system to lag/slow down (1). Accept any other relevant phrasing/wording.	**(4)**

Question number	Indicative content
3(c)	Answers will be credited according to the learners' demonstration of knowledge and understanding of the material, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some/all of the indicative content but should be rewarded for other relevant answers. The packet is structured into Header, Payload and Footer/trailer **Header** • Packet number – allows computer to reassemble packets to correct order, as they may arrive at different times depending on the route they took. • IP addresses – to identify sender and receiver, ensuring the data gets to where it should, and that the system sending the data can be contacted to request data to be resent as necessary. • Protocol – tells the system how the data should be transmitted and processed, at each stage of the transmission. **Footer** • Contains data to show it is the end of the packet, so the system can start to process it. • Error check/error correction data to automatically identify any corruption, so resending of packet can be requested if needed, without interaction from the intended user/recipient.

Mark scheme (award up to 8 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.

Level	Mark	Descriptor
Level 0	0	No rewardable material.
Level 1	1–2	Technical vocabulary is used but it is not used appropriately to support arguments in relation to the issues of the question. Issues are identified but chains of reasoning are not made, leading to a superficial understanding of the relative importance of issues to the scenario.
Level 2	3–5	Accurate technical vocabulary is used to support arguments but not all are relevant to the issues of the question. There is consideration of relevant issues using logical chains of reasoning but it does not reflect on their relative importance to the given scenario.
Level 3	6–8	Fluent and accurate technical vocabulary is used to support arguments that are relevant to the issues of the question. There is a balanced and wide-ranging consideration of relevant issues using coherent and logical chains of reasoning, which shows a full awareness of their relative importance to the given scenario.

Question number	Indicative content
3(d)	Answers will be credited according to the learners' demonstration of knowledge and understanding of the material, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some/all of the indicative content but should be rewarded for other relevant answers. Provision of an evaluation of the decision, stating if decision is appropriate or not and supported by relevant points which may include: • effect on ability to use current information systems (registers etc.), due to potential file system differences on open source operating systems • compatibility with existing software: o requirement to license new compatible software o find ways of making it compatible on the new system (time consuming, require additional staff/support) o find open source alternatives which may not exist or may offer different functionality • compatibility of document formats when sharing files (schools, parents, pupils' homework): o may be difficult, if not saved using portable formats. Users required to 'relearn' how to save their documents o documents sent by others may be saved in proprietary formats, making it difficult to access items from other locations • similarity/difference to home systems: o interfaces and functions of the systems may be different and cause users to have trouble completing tasks the way they might like, so tasks take longer to complete o additional training might be need for all • preparation for further study: o not using proprietary software may disadvantage pupils when they move to other settings that use proprietary software, so have to relearn again • cost: o may be cheaper than proprietary software; often free software options o open source operating systems used on larger scale, may require 'enterprise' grade operating systems and servers, which incur a cost • staff time to update existing teaching materials, in order to use them on the new system (file formats/how to guides etc.) • teaching and administrative staff training requirements, to be able to use new systems: o time consuming o cost o finding a training supplier with the open source expertise required • retraining of existing IT support staff or new staff requirement • advantages and disadvantages of community support versus paid for support • scope of customisation with open source customisation • wider range of choice of variations on the operating system are available • transition considerations: o complexity of transferring to new system o time required.

Mark scheme (award up to 12 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.		
Level	**Mark**	**Descriptor**
Level 0	0	No rewardable material.
Level 1	1–4	Technical vocabulary is used but it is not used appropriately to support arguments in relation to the issues of the question. Issues are identified but chains of reasoning are not made, leading to a superficial understanding of the relative importance of issues to the scenario. No conclusion is presented or is generic.
Level 2	5–8	Accurate technical vocabulary is used to support arguments but not all are relevant to the issues of the question. There is consideration of relevant issues using logical chains of reasoning but it does not reflect on their relative importance to the given scenario. An attempt at a conclusion is presented that links arguments to the given scenario but is not justified, in that it does not reflect the careful consideration of both sides of the argument.
Level 3	9–12	Fluent and accurate technical vocabulary is used to support arguments that are relevant to the issues of the question. There is a balanced and wide-ranging consideration of relevant issues using coherent and logical chains of reasoning that show a full awareness of their relative importance to the given scenario. A fully justified conclusion is presented that links arguments to the given scenario, and which reflects the careful consideration of both sides of the argument, leading to a reasoned decision.

Question number	**Answer**	**Mark**
4(a)	Award **1** mark for identification and **1** mark for appropriate expansion. • Array data is stored in adjacent memory locations (1) and must be accessed sequentially (1). • Array data must be stored sequentially (1), so space must be cleared and reserved for the whole array (1). Accept any other relevant phrasing/wording.	**(2)**

Question number	Answer	Mark
4(b)	Award **1** mark for each related descriptive point up to a maximum of **4** marks. • The MAR holds the address(es) of data/instructions stored in main memory (1). • (When the ALU requires data/instructions) the address is requested from the MAR and passed to the MDR (1.) • The contents of the address are conveyed to the MDR from the given memory location (using the data bus) and stored ready for use by the ALU (1). • When data is no longer needed by the ALU, data may be sent back to main memory by the MDR (1). • The data location (of the data that has been sent back to main memory) is updated and sent to MAR (using the address bus) (1). Accept any other relevant phrasing/wording.	**(4)**

Question number	Answer	Mark
4(c)	Award **1** mark for identification and **1** additional mark for appropriate expansion, up to a maximum of **2** marks each. • Processors in NUMA systems have memory dedicated to each processor (local memory) (1), so does not have to wait for (foreign) memory that is being used by other processors (1). • CPUs do not have to share the same memory bus (1), reducing conflict/strain on shared resources (1). • More scalable (better results from adding more CPUs) (1), due to reduced use of shared resources (1). Accept any other relevant phrasing/wording. Accept any other valid response.	**(4)**

Question number	Indicative content
4(d)	Answers will be credited according to the learners' demonstration of knowledge and understanding of the material, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some/all of the indicative content but should be rewarded for other relevant answers. Analysis of how image data is stored and represented in a computer system and the impact it has on the image and its use. **Resolution** • Image in a computer system is displayed as a bitmap which is a collection of coloured 'dots' that makes up the image. Bitmap image resolution is measured by the number of dots in width and height (e.g. 800x600). • Quality is affected by the number of dots that are displayed per inch (dpi). The higher the number of dots per inch, the clearer an image will appear. • The dots/pixels are difficult to see at standard zoom level. The higher the pixel count, the larger an image can be displayed. Typically, the higher the resolution, the more storage space an image will need to be stored. Requires consideration of the size of intended use of the image. Trade-off between efficient use of storage and ensuring the final image can be used as intended. **Sample/bit depth** • Bit depth of an image refers to the number of bits per pixel that are used to store image colour data. The higher the bit depth, the more unique colours can be displayed. The number of unique colours that can be displayed is calculated by: Number of colours = $2^{\text{bit depth}}$ • When choosing a suitable bit depth, there is a need to consider the detail that the image needs to display. Images of a higher bit depth would typically have a larger file size, requiring more storage space but this allows greater flexibility in the way they are used/manipulated. **Bitmap/raster vs vector image** • The nature of digital displays means that all images are displayed as bitmaps. Most image formats store images in bitmap format. Vector images store the image information as a series of points, lines and curves which are based on a mathematical formula. On image resizing, the formula is recalculated so that the scale and resolution of the image adapts making it infinitely scalable. • Owing to the limited amount of the stored information, vector images typically have a small file size. • Digital cameras typically render images at bitmaps, so need to convert the images into vectors before using them, which may be time consuming or impractical. • The nature of vectors (based on curves, lines etc.) makes them typically more suited for non-real images (drawings, diagrams etc.), rather than photographs. **Compression** • Image compression is used to reduce the amount of memory an image will take up. It is typically applied to an image before it is uploaded to the internet. • Lossy compression – removes data that is perceived as not needed. The colour depth might be varied, so that shades that are so close that the human eye will not be able to tell them apart, are converted to the same shade, so less data stored. Compression can remove additional metadata, which may be of use in future.

Question number	Indicative content	
	• Lossless compression – uses mathematical formulas to calculate and map the exact representation of an image colour map, so that it can be recreated exactly as is. Stores more data than lossy compression, so it typically does not reduce file size as far as lossy compression does. • Both forms of compression change the file format that the image would use. Could have an impact on how it can be used/manipulated in the future. File format choice needs to be considered, with reference to that appropriate for intended uses.	
Mark scheme (award up to 12 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.		
Level	**Mark**	**Descriptor**
Level 0	0	No rewardable material.
Level 1	1–4	Technical vocabulary is used but it is not used appropriately to support arguments in relation to the issues of the question. Issues are identified but chains of reasoning are not made, leading to a superficial understanding of the relative importance of issues to the scenario.
Level 2	5–8	Accurate technical vocabulary is used to support arguments but not all are relevant to the issues of the question. There is consideration of relevant issues using logical chains of reasoning but it does not reflect on their relative importance to the given scenario.
Level 3	9–12	Fluent and accurate technical vocabulary is used to support arguments that are relevant to the issues of the question. There is a balanced and wide-ranging consideration of relevant issues, using coherent and logical chains of reasoning that show a full awareness of their relative importance to the given scenario.

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