1 Application software is run on thin client computers. A thin client computer is a very low-powered computer connected to a powerful central server. The operating system and all the applications run within a virtual machine on the server. The thin client computer will only display the output of the virtual machine and capture and send input to the virtual machine.

The thin client computer needs to send data that is input by the user to the server so that the virtual machine can process it. For example, it will send text entered by the user on the thin client computer to the application software running on the virtual machine.

Data is compressed in order to improve the speed of data transmission between the client and the server.

Explain why lossless compression should be used instead of lossy compression.

[3]

2 A team of programmers create a robot that will be used in a factory. The robot will be able to do the work of multiple humans.

The programmers discuss whether to write the instructions for the robot in assembly language or a high-level language.

The robot stores data internally and also communicates with other robots and users via a wireless network which is password protected. All data for these tasks is secured using either encryption or hashing.

Compare the robot's use of encryption and hashing for storing and communicating data.

You should include the following in your answer:

- the different types of encryption that could be used and how this would secure data
- how hashing could be used to secure data and which data would be suitable
- why encryption and hashing are used by the robot for stored data and communications.

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

[9]

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

3 All videos that are streamed are compressed. Customers have the option to choose from watching the videos with lossy compression or lossless compression.

Explain how this choice will impact the customer.

[5]

4 Shreya is a web developer who creates webpages for a variety of different companies.

Photographs on a webpage are usually compressed.

i. State which method of compression is most likely to be used for this purpose.

[1]

ii. Explain the need to compress photographs in this situation.

[2]

5(a) A survey is carried out to look at the types of vehicle that travel down a stretch of motorway.

For each vehicle that passes by, a letter is entered into the system.

For a car ‘C’ is entered.

For a motorbike ‘M’ is entered.

For a lorry ‘L’ is entered.

For any other vehicle ‘O’ is entered.

It is decided to compress the data that has been generated.

State what is meant by the term ‘compression’.

---

[1]

(b) It is decided that Run Length Encoding will be used.

The following sequence has been compressed using Run Length Encoding.

`3C3M4C`

Show the result of decompressing the sequence.

---

[2]

(c) Show the result of using Run Length Encoding to compress the sequence:

`CCCCOLLLCCCCCMOCCCCC`

---

[3]

---

6 * Modern encryption is much stronger than the method described in the first part of this question.
Discuss the impact of modern encryption on society. You should refer to:

- The importance of asymmetric encryption and how it differs from symmetric encryption.
- Different circumstances in which symmetric and asymmetric encryption may be used.

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

---

[9]

7(a) A web forum stores all its content in a database.

The forum stores details of its users in the table called `Users`. An extract of `Users` is shown below.

userID	**username**	**passwordHash**	**locked**
1	Zeus	8dfa46a79248037752bba6166fcb34f8	1
2	Hera	74d39d60507eb55e000c6ec5c1265891	0
3	Poseidon	b015d770d0208ddcce2c2c719fe29371	0

Describe what is meant by the term ‘primary key’, giving an example from the table above.

---

[2]

(b) The user's password is passed to a function that generates a hash and the result is stored in `passwordHash`.

i. Describe what is meant by the term 'hash'.

---

[1]

ii. Describe **one** advantage to storing the password as a hash.

---

[2]

(c)

Write an SQL statement to get just the `passwordHash` and `locked` values of the user `Apollo`.

[3]

(d)

Sometimes users can have their accounts locked if they behave inappropriately. When this is the case the `locked` field is set to 1 rather than 0.

Write an SQL statement that locks the account of the user `Hades`

[3]

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

(e) The function `checkAccess` takes in the password the user has entered (`givenPassword`) along with the password hash (`passwordHash`) and locked value (`locked`).

`passwordHash` and `locked` have already been extracted from the database before being passed to the function. It should return the value `true` if a user should be allowed access to a system and `false` if they aren't.

Your function should make use of the pre-written function `hash()` which takes in a string and returns the hash of that string.

e.g.

`hash("Hello")` returns `f7ff9e8b7bb2e09b70935a5d785e0cc5d9d0abf0`

Complete the function `checkAccess`.

```
function checkAccess (givenPassword, passwordHash, locked)
```

```
endfunction
```

[4]

8(a) A charitable organisation is trying to make the works of William Shakespeare available to more people.

The organisation decides to make a copy of Shakespeare's entire works available as a downloadable text file from its website. It further decides to compress the file before making it available to download.

i. State an advantage to the website's visitors of the file being compressed.

---

[1]

ii. Explain why the company should use lossless and not lossy compression.

---

[3]

(b) 

The organisation looks at using either run length encoding or dictionary encoding to compress the file described in **part (a)**.

Discuss the **two** compression methods and justify which you would recommend. You may refer to the extract of text below to illustrate your argument.

What's in a name? that which we call a rose
By any other name would smell as sweet;
So Romeo would, were he not Romeo call'd,

[12]

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

END OF QUESTION PAPER

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

Question			Answer/Indicative content	Marks	Guidance
1			1 mark per bullet to max 3: • Lossless will not **permanently** remove data • Lossless can be fully reconstructed/restored • Quality (of text/graphics/sound) is not lost • Any loss of text would be noticeable/would make it unreadable/unusable • Lossless rewrites data in a more efficient format	3	Accept reverse points e.g. lossy will delete data **permanently** Examiner's Comments This is a common topic in previous papers and most candidates were able to gain at least one mark with more successful candidates gaining all three. Some candidates gave responses that were too vague and did not relate to the question stem.
			Total	**3**	
2			**Mark Band 3 – High Level (7–9 marks)** The candidate demonstrates a thorough knowledge and understanding of encryption **and** hashing and how they can be used to store data and communicate securely. The material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation. The candidate is able to weigh up both technologies which results in a supported and realistic judgement covering when each can be used. This is well balanced. There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated. **Mark Band 2 – Mid Level (4–6 marks)** The candidate demonstrates reasonable knowledge and understanding of encryption **and** hashing and how they can be used to store data and communicate securely; the material is generally accurate but at times underdeveloped. The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence / examples are for the most part implicitly relevant to the explanation.	9	*The following shows example content that may form part of a candidate's answer. It is not intended to be an exhaustive resource, nor should a candidate be expected to specifically cover any particular amount of this.* **Knowledge (AO1)** • Encryption converts data into data that cannot beunderstood (ciphertext) using a key. • Symmetric encryption uses the same key for bothencryption and decryption • Asymmetric encryption uses two keys, one forencryption, one for decryption • Encryption is two-way, so data can be restored tooriginal form, but key is required. • Hashing is a one-way (non-reversible) mathematicalprocess that produces a value from the input value. **Application (AO2)** • For robot's data storage, symmetric encryption isuseful as no keys to share/transmit. • For robot-robot/user communication, asymmetricencryption / public key encryption means that onlythe public key needs to be shared. Data can beencrypted/decrypted with this while the private key iskept secure • Also possible to verify identity of sender / origin ofdata using asymmetric encryption. • Hashing is useful for information (e.g. password) thatneeds to be verified but does not need to be knownat any

Question			Answer/Indicative content	Marks	Guidance
			The candidate makes a reasonable attempt to come to a conclusion showing some recognition of either technology. This may not be well-balanced, covering one side significantly more than the other, although both sides will be present. There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence. **Mark Band 1 – Low Level (1–3 marks)** The candidate demonstrates a basic knowledge of encryption or/and hashing and how they can be used to store data and communicate securely; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided. The candidate provides nothing more than unsupported assertions. Any discussion will be almost entirely one-sided. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear. **0 mark** No attempt to answer the question or response is not worthy of credit.		point; once hashed, it is impossible to returnto it. **Evaluation (AO3)** • Encryption useful for most data storage as anyonehacking into the robot will not be able toread/understand the data. • Hashing is useful for data storage of password /other items that need to be verified, hash of inputcompared against hash stored to confirmcorrectness. • Hashing is not useful for data that needs to bereturned to the user as impossible to return to. • Encryption useful for data transmission as dataintercepted cannot be decrypted without the key. Examiner's Comments Most candidates could name symmetric and asymmetric encryption and state how the keys in each were used as well as being able to show a basic understanding of hashing being irreversible but few could apply that to the question. Many talked about hash tables although the question states that hashing is used to secure the data.
			Total	**9**	
3			• Lossy **permanently** removes data • Lossless rewrites original data in more efficient format • Lossless is able to recreate the original file // Lossy is not able to recreate the original file • Lossy reduces quality of videos // Lossless keeps original quality • Lossy file size is smaller than if lossless were used • Lossy: compression ratio may be adjusted depending on bandwidth • Resulting in a noticeable decrease in quality on slower connections. • Lossy: the video will buffer less / quicker to start watching the video // Lossless: the video will buffer more / slower to start watching the video	5	Do not allow answers relating to speed of download unless this clearly refers to the video starting or reduction in buffering – scenario is video being streamed, not downloaded. Examiner's Comments Candidates tended to write at length for this question, but often made the same point twice. Many missed marks for not making the comparison between lossy and lossless and only gave one side. Some candidates discussed the videos being downloaded rather than streamed.

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

Question			Answer/Indicative content	Marks	Guidance
			Total	5	

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

Question			Answer/Indicative content	Marks	Guidance
4		i	Lossy	1 AO2.1 (1)	
		ii	1 mark per bullet up to a maximum of 2 marks, e.g.: • Reduces the size of the image file • Uses lower bandwidth in transmission • Takes up less storage (on the HTTP server)	2 AO2.1 (2)	
			Total	**3**	
5	a		(The process of) making a file smaller/take up less storage	1 AO1.1	
	b		Full answer CCCMMMCCCC – CCC – … followed by MMMCCCC (1 per -, max 2)	2 AO1.2	
	c		4C1O3L5C1M1O5C – 4C1O – Followed by 3L5C – Followed by 1M1O5C	3 AO1.2	Accept answer without 1s <u>Examiner's Comments</u> Well answered by most candidates, demonstrating clear understanding of Run Length Encoding as a method of compression.
			Total	**6**	

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

Question			Answer/Indicative content	Marks	Guidance
6			**Mark Band 3-High Level (7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of modern encryption and the difference between symmetric and asymmetric encryption. The material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation. The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered. There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated. **Mark Band 2-Mid Level (4-6 marks)** The candidate demonstrates reasonable knowledge and understanding of modern encryption and the difference between symmetric and asymmetric encryption; the material is generally accurate but at times underdeveloped. The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation. The candidate provides a sound discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed. There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence. **Mark Band 1-Low Level (1-3 marks)** The candidate demonstrates a basic knowledge modern encryption and the difference between symmetric and asymmetric encryption; the material is	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	**AO1** Modern encryption is many orders stronger than that used in a pre-computer era. Asymmetric encryption uses different keys for encryption and decryption. Symmetric encryption uses the same key for encryption and decryption. Asymmetric encryption algorithms tend to involve more processing than symmetric algorithms. **AO2** Modern encryption can be used without specialist knowledge. Often users may not even be aware their data is being encrypted (e.g. HTTPS, messaging systems) Asymmetric encryption is often used when exchanging data. For example credit card details over the internet. Symmetric encryption is best suited when the same person is encrypting and decrypting. For example when backing up data. **AO3** The strength and ease of use of encryption has made it widely used on the Internet. E-Commerce would not be possible without it. Governments are no longer able to easily crack encrypted messages they intercept (as far as we know). This gives individuals unprecedented levels of privacy But also means those communicating for nefarious purposes can do so undetected. **Examiner's Comments** Candidates were assessed on the quality of their extended response in this question. Many candidates explained the difference between symmetric and asymmetric encryption very well. Some went on to describe the circumstances in which they are used equally well. Few discussed the impact on society. Many candidates scored in the mid band on this question.

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

Question			Answer/Indicative content	Marks	Guidance
			basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided. The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear. 0 marks No attempt to answer the question or response is not worthy of credit		
			Total	9	

Question			Answer/Indicative content	Marks	Guidance
7	a		A field which has a unique value for every record / A unique identifier. (1) E.g. userID (1)	2 (AO1.1 – 1, AO2.1 -1)	**Examiner's Comments** Well received and answered by most candidates.
	b	i	A result generated by applying an algorithm / numeric process to a value. (1)	1 (AO1.1)	
		ii	Hash functions are one way / can't be reverse (1) If someone gains access to the database they cannot access user's password. (1)	2 (AO1.2 1 mark, AO2.1 1 mark)	**Examiner's Comments** Many candidates achieved the mark in part i) few achieved both marks in part ii) mostly stating as opposed to describing the advantage e.g. 'those who gain unauthorised access cannot access passwords' without going on to say 'hash functions are one way'.
	c		`SELECT passwordHash, locked` (1) `FROM Users` (1) `WHERE username='Apollo'` (1)	3 (AO 3.2)	Do not award first mark for SELECT * **Examiner's Comments** In most cases, candidates who achieved marks in c) went on to achieve marks in d) with few candidates achieving all marks in either. Many candidates did not use correct SQL statement structure or syntax e.g. confusing attribute names with string literals.

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

Question			Answer/Indicative content	Marks	Guidance
	d		`UPDATE Users` (1) `SET locked=1` (1) `WHERE username='Hades'` (1)	3 (AO 3.2)	Allow other updating method e.g. a DELETE statement followed by an INSERT statement, for full marks e.g. `DELETE FROM Users` `WHERE username = 'Hades'` (1 mark) `INSERT INTO Users` (1 mark) `VALUES (<userID value>,'Hades',<passwordHash value>,1)` (1 mark) **Examiner's Comments** In most cases, candidates who achieved marks in c) went on to achieve marks in d) with few candidates achieving all marks in either. Many candidates did not use correct SQL statement structure or syntax e.g. confusing attribute names with string literals.

	e		Takes a hash of `givenPassword` (NB this may be done inline e.g. `if hash (givenPassword)==passwordHash and locked==0 then` (1)
			
			Returns true if password is correct and account is unlocked. (1)
			
			Returns false if account is locked (1)
			
			Returns false if password is incorrect (1)
				4
				
				(AO 3.2)
					Example code:
					`temp = hash(givenPassword)`
					`if temp==passwordHash and locked==0 then`
					`  return true`
					`else`
					`  return false`
					`endif`
					
					Candidates may have taken a different approach - any solution that fulfils the criteria on the left should get them marks.
					
					Examiner's Comments
					Candidates were asked to complete a function in this question. Although many students demonstrated reasonable logic in solving this problem, some used output statements rather than returned values from the function, therefore, not gaining full marks.

			Total	15	

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

Question			Answer/Indicative content	Marks	Guidance
8	a	i	Downloads quicker. (1) Saves user money by using less bandwidth / on data usage. (1) (Max 1)	1 (AO1.2)	Do not accept 'saves the user space on their device'. Examiner's Comments This question was well received by most candidates, invariably scoring most marks.
		ii	Lossy takes away some of the information from the original. (1) Lossless preserves all the information from the original. (1) With text the loss of small amounts of information will make it unreadable. (1)	3 (AO1.1 – 2 marks AO2.1 – 1mark)	

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

Question			Answer/Indicative content	Marks	Guidance
	b		**Mark Band 3–High Level (9–12 marks)** The candidate demonstrates a thorough knowledge and understanding of dictionary and run length encoding for compression. The material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence / examples will be explicitly relevant to the explanation. The candidate is able to weigh up both forms of compression and justify dictionary encoding being the better choice. There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated. **Mark Band 2-Mid Level (5–8 marks)** The candidate demonstrates reasonable knowledge and understanding of dictionary and run length encoding for compression; the material is generally accurate but at times underdeveloped. The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence / examples are for the most part implicitly relevant to the explanation. The candidate makes a reasonable attempt to come to a conclusion as to which form of compression is better suited. There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence. **Mark Band 1-Low Level (1–4 marks)** The candidate demonstrates a basic knowledge of dictionary and run length encoding for compression; the material is	AO1.1 (2) AO1.2 (2) AO2.1 (3) AO3.3 (5) 12	Points may include but aren't limited to: **AO1 Knowledge and Understanding** Run length encoding relies on consecutive pieces of data / characters being the same. Each set of consecutive symbols can be represented by the symbol and its number of occurrences e.g. AAAABBBBBCCC could be represented as 4A5B3C (or A4B5C3 or any sensible RLE encoding) In dictionary encoding frequently occurring pieces of data / groups of characters are replaced by symbols / tokens / smaller groups of characters / indexes. A dictionary is then used to say which symbols / tokens / characters / indexes match which groups of characters. When decompressed the dictionary is used to replace the tokens with the original text. **AO2.1 Application** Run Length Encoding is very unsuitable for the example text. There are very few consecutive repeating symbols in the text. only instances being ll and ee these still require 2 characters to represent them 2l and 2e Dictionary encoding is well suited. There are lots of repeating groups of characters For example 'call' 'name' '[SPACE]we' 'Romeo' We could for example have: What's in53? that which2 15 rose By5ny other3 would smell5s sweet; So4would,2re he not41'd 1:call 2:[space]we 3:[space]name 4:[space]Romeo[space]

© OCR 2026. You may photocopy this page.

Created in ExamBuilder

Question			Answer/Indicative content	Marks	Guidance
			basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided. The candidate provides nothing more than an unsupported assertion. 0 marks No attempt to answer the question or response is not worthy of credit.		5:[space]a (NB candidates are unlikely to show full compression, just a demonstration of the principle is sufficient. The best candidates are likely to show an awareness that space is a character that can be used in compression and that upper and lowercase letters are different. Demonstrating this is indicative of but not a requisite of the band.) AO3.3: Evaluation Run length encoding is not suited to natural language (more likely to be used in simple images). Applying it to the example the resulting text would be the same size as the original / worse than the original (if we use 1s to represent every individual instance of a character). Dictionary encoding works well. We can already see benefit on small piece of text. Would fare substantially better on full works. Dictionary encoding is the best compression method for this scenario. Examiner's Comments Candidates were assessed on the quality of their extended response in this question. Most candidates could describe each of the given types of compression appropriately, with many applying them to the scenario. Many candidates correctly concluded that dictionary encoding was the most appropriate in this case, but few then went on to give clear and appropriate justification for their assertion. In general, most candidates scored well on this question.
			Total	16	

© OCR 2026. You may photocopy this page.

Created in ExamBuilder