Topic 3

Exchanging Data

1(a) State **two** benefits of using a relational database instead of a flat file database.

1 ---

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2 ---

[2]

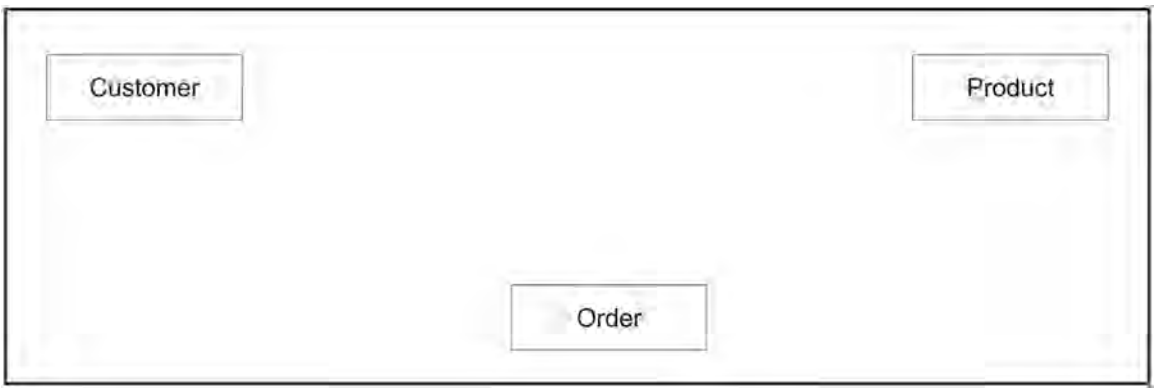
(b) OCRConfectionery is a sweet manufacturing company.

They want to use a relational database to store details of the orders their customers make.

One customer can order as many different products as they like in the same order. A customer can also place as many orders as they like.

One product can be ordered multiple times in the same order or ordered by multiple different customers.

Complete the entity relationship diagram to show the relationships between the Product, Customer and Order entities.



[2]

(c) The order table has these fields.

OrderID
OrderDate
OrderAmount
CustomerID
ProductID

(i) State the difference between a primary key and a foreign key.

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[2]

(ii) State **one** foreign key in the order table.

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[1]

(iii) State why CustomerID would not make a suitable primary key in the order table.

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[1]

2(a) 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.

[9]

(b) The robot provides a web-based interface for users. The home screen webpage for this interface is shown in **Fig. 4**.

Fig. 4

(i) Complete this HTML code that will display the webpage shown in **Fig. 4**.

```
<html>
    <head>
        <title>Robot User Interface</title>
    </head>
    <body>
        <h1>Robot prime directives</h1>
        ……
            <li>Serve the company trust</li>
            <li>Protect data</li>
            <li>Uphold standards</li>
        ……
    <a …… = "updates.html">Updates</a>
    <p>……</p>
    <form action="dologin.php">
        Password
        <input type = "……" name="pw">
        <input type = "……">
    </form>
    </body>
</html>
```

[5]

(ii) Write CSS code that could be used in an external stylesheet to format all text using the <h1> tag as white with a red background.

---

[3]

(c) The robot's web interface uses images that show the robot in action. These photographs have been taken using a digital camera.

The programmers do not want other people to download and use these images.

(i) State the name of **one** relevant piece of legislation and describe how this would protect these images.

Legislation _____

_____

Description _____

_____

_____

_____ **[3]**

(ii) For other areas of the web interface, the programmers need to use images that they have not created themselves.

Give **two** ways that they could make sure these images are used legally.

1 _____

_____

2 _____

_____ **[2]**

3 A small manufacturing business uses networked computers with closed source application software installed.

All computers owned by the business are connected together into a Local Area Network (LAN). Various network protocols are used in this network.

(i) Give **three** advantages to the business of connecting computers together in a LAN.

1 ---

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2 ---

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3 ---

--- **[3]**

(ii) Explain what is meant by a network protocol.

--- **[2]**

(iii) Give the names of **two** protocols that may be used in a LAN.

1 ---

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2 ---

[2]

(iv) Explain why protocol layering is used.

[3]

4(a) Zac has an accountancy business. He is moving into an office that has enough space for up to five members of staff. Zac would like to install a Local Area Network (LAN) to allow his staff to work together.

(i) A LAN uses packet switching.

Describe **one** difference between packet switching and circuit switching.

---

[2]

(ii) Explain why packet switching is more suitable for a computer network than circuit switching.

---

[2]

(b) Zac has hired a company that will advise him on what type of LAN he should set up.

Discuss how Zac could set up a peer-to-peer network and a client-server network.

You should refer to the following in your answer:

- how the computers in each type are connected
- the benefits of each type
- the drawbacks of each type
- the suitability of each type.

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[9]

5 Anika's computer runs a multi-tasking operating system. She has access to a printer and a broadband internet connection through a wireless connection. The operating system uses scheduling algorithms such as first come first served and round-robin.

Anika uses an encrypted messaging program to communicate with her friends. The computer uses the TCP/IP stack.

(i) Explain what happens at the application layer of the TCP/IP stack when using this program.

[5]

(ii) Explain what happens at the link layer (sometimes referred to as the "network interface layer", "network access layer" or simply the "network layer") of the TCP/IP stack when using this program.

[2]

6(a) A relational database supports ACID transactions. ACID stands for Atomicity, Consistency, Isolation and Durability.

(i) Describe what is meant by a transaction being durable.

[2]

(ii) Give **one** way that durability can be achieved for a completed transaction.

[1]

(iii) Explain how record locking can be used to ensure that the ACID principle of isolation is achieved when carrying out multiple transactions.

[3]

(iv) Give **one** disadvantage of using record locking.

[1]

(b) 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]

(c) A video streaming service uses a relational database. An extract of the data from two tables from this database is shown in **Fig. 2**.

`Membership` contains data about current memberships that customers hold and `package` contains data about different streaming packages available.

Username	FirstName	StartDate	PackageType
User001	Amaya	08/05/2016	Premium
User002	Amit	06/06/2019	Basic
User003	Tom	17/08/2019	Free
User004	Kareem	08/08/2017	Basic
User005	Sarah	25/03/2020	Premium

Membership

PackageType	CostPerMonth(£)	Adverts
Premium	12.99	false
Basic	7.99	true
Free	0.00	true

Package

Fig. 2

(i) State what is meant by the term 'primary key'.

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[1]

(ii) Identify the foreign key used in the database and the table name where this is a foreign key.

Foreign Key ---

Table Name ---

---

[2]

(iii) Identify the data type of the `CostPerMonth(£)` field.

---

[1]

(iv) Give the name of the field that could be stored using a Boolean data type.

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[1]

(d) The `Adverts` field indicates if customers will be shown adverts. `true` indicates that customers will be shown adverts, and `false` indicates that adverts are not shown.

Write Structured Query Language (SQL) to return the `Username` and `FirstName` fields for all customers who see adverts.

[5]

7(a) The protocol TCP/IP uses a 4-layer stack.

(i) Complete the table below to show the 4 layers in the TCP/IP stack.

Application
Link

[2]

(ii) Explain **one** advantage of using layers in the protocol TCP/IP.

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[2]

(b) Modern computer systems use networking in order to share hardware, software and data.

Networking uses protocols such as TCP/IP.

State what is meant by the term 'protocol'.

---

[1]

8 A delivery company sends parcels across the UK.

To prove parcels have not been damaged in transit, the delivery drivers use a digital camera to take a photograph of them when they arrive at their destination. The digital camera uses flash memory.

(i) Describe one advantage of the digital camera using flash storage rather than magnetic.

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[2]

(ii) Explain whether lossless or lossy compression would be most appropriate to store the photographs. Justify your response.

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[3]

9 A company releases an Internet connected fridge. Users can email messages to the fridge and it puts them on its display.

The fridge uses the TCP/IP stack.

Explain what is meant by the term 'TCP/IP stack'.

[3]

10 The following JavaScript has been found to crash certain web browsers.

```
Line    Code
1       var total = "";
2       for(var j = 0; j < 200000; j++)
3       {
4         total = total + j.toString();
5         history.pushState(0,0, total);
6       }
```

`j.toString()` converts `j` to a string. It is the JavaScript equivalent to `str(j)`.

Complete the table below.

Line	Effect of Code
1	
2	
3	
4	
5	Pushes `total` onto a stack that holds the browser's history.
6	

[2]

[1]

[1]

11(a) Users are able to search for and find the ticket website using a search engine. Search engines can use indexing and ranking.

(i) Describe how a website is indexed by a search engine.

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[4]

(ii) A search engine can use the PageRank algorithm to determine a website's ranking. The PageRank algorithm utilises a damping factor.

State what is meant by the term 'damping factor'.

[1]

(iii) Give **two** other factors that affect the output value given by the PageRank algorithm for a website.

1

2

[2]

(b) A website sells tickets for sporting events. The website uses HTML, CSS and JavaScript.

Describe the purpose of HTML and CSS within the code of the website.

HTML _____

_____

_____

_____

CSS _____

_____

_____

_____

[4]

12 Customers' details are stored in the flat file database table `Customer`. An extract of the table is shown below.

CustomerID	**Surname**	**Title**	**Phone**	**CarReg**
JJ178	James	Mr	(0121) 343223	DY51 KKY
HG876	Habbick	Miss	(01782) 659234	PG62 CRG
EV343	Elise	Mrs	(07834) 123998	HN59 GFR
PG127	Pleston	Mr	(07432) 234543	JB67 DSF

(i) State what is meant by the term 'primary key', identifying the primary key in the table above.

---

[2]

(ii) Write the SQL statement that would show only the `CustomerID` and `Surname` fields for customers with the `Title` "Miss" or "Mrs".

---

[4]

(iii) Describe **one** problem that would arise with the flat file database structure if a customer wanted to insure more than one car at the same time.

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[2]

(iv) Describe how the flat file database structure could be altered to efficiently allow each customer to insure multiple cars at the same time. (You may assume each car is insured to only one customer.)

[5]

13(a) A hotel uses a computer system to keep track of room bookings. The hotel staff are able to query a database to discover which rooms are booked or which rooms are free.

The hotel's computer network uses a client-server model.

(i) Describe what is meant by the term 'client-server' in this context.

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[3]

(ii) Give **two** advantages of client-server compared to peer-to-peer.

1 ---

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2 ---

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[2]

(b) The hotel's network uses multiple switches.

Explain the purpose of a network switch.

[3]

(c) * The hotel is concerned about the security of its computer network.

Discuss the threats which potentially exist to the hotel's computer network and how these threats could be eliminated or reduced.

[9]

(d) The hotel stores data about rooms, customers and bookings in a database. Each customer can book multiple rooms and each room can be booked multiple times.

(i) Draw an Entity Relationship Diagram for this database.

[4]

(ii) Define what is meant by the term 'foreign key', giving **one** example of where a foreign key would be used in the hotel booking database.

Definition ----------

Example ----------

---

[3]

(iii) Describe **two** different ways that hashing could be used in this database.

1 ---

---

2 ---

---

[4]

(e) The hotel booking database enforces referential integrity.

Explain what is meant by the term 'referential integrity' and how this could potentially be broken.

[2]

14 *A company has six solicitors working in two offices in different locations. They work with the general public and help them solve any sensitive legal issues they may be facing.

The solicitors would like to set up a computer network to allow them to work together more effectively.

Discuss the benefits and drawbacks of computer networking to the company.

You should refer to the following in your answer:
- Different networking methods
- Cost implications
- Security implications

[9]

15 RestaurantReview is a website that allows users to leave reviews and ratings for different restaurants.

The website uses a database with the following structure.

The database management system ensures referential integrity is maintained.

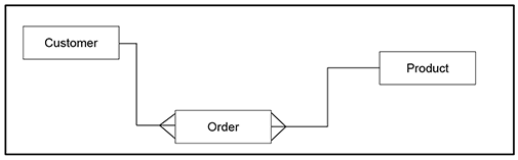
Whenever a review is added to the system, the restaurant's average rating is updated. This transaction is ACID.

The A in ACID refers to Atomic.

Describe what is meant by the term 'Atomic' in the context of ACID transactions. You should refer to the example of a review being added.

[2]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a		• Relational data allows for less redundancy of data/less repeated data • Relational databases improve the consistency of data • Relational databases allow for **complex** queries and/or searches to be performed	AO1.2 (2)	<u>Examiner's Comments</u> This question was generally answered well, although some candidates did not use the correct terminology and therefore could not be given all the available marks.
	b		 • One to Many relationship between Customer (one) and Order (many) • One to Many relationship between Product (one) and Order (many)	AO3.1 (2)	• Ignore any relationship between customer and product. • Correct answer only <u>Examiner's Comments</u> This question required candidates to correctly draw the relationships between the entities as explained in the question. Candidates were expected to indicate the relationships. Some candidates used either words or other symbols to indicate the relationships, therefore not achieving either of the available marks. Some candidates used a link entity to avoid a many to many relationship between product and order or indicated a relationship of one product to many orders. Either of these responses were acceptable. **Assessment for learning** Appendices 5c in the specification shows the symbols used for entities and their relationships. Students need to be taught these to use in the exam.

Question			Answer/Indicative content	Marks	Guidance
	c	i	• A primary key will only appear once in a table/is a unique identifier • A foreign key may appear multiple times a table/may not be unique	AO1.1 (2)	Accept entity for table Examiner's Comments Many candidates were able to state what a primary key is, but did not state the difference between this and a foreign key and therefore did not achieve both marks.
		ii	• CustomerID • ProductID	AO2.2 (1)	Correct answer only Examiner's Comments This question was generally answered well, although some candidates lost marks for mis-spelling the foreign key or adding spaces, both of which are not permitted.
		iii	There may be duplicate values.	AO2.2 (1)	Examiner's Comments This question was generally answered well with many candidates gaining the mark.
			Total	8	

Question			Answer/Indicative content	Marks	Guidance
2	a		**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. The candidate makes a reasonable attempt to come to a conclusion	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

Question			Answer/Indicative content	Marks	Guidance
			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.		knownat any 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.

Question			Answer/Indicative content	Marks	Guidance
	b	i	• and • href • Login • text/password • submit	5	<html> <head> <title>Robot User Interface</title> </head> <body> Robot directives - Serve the company trust - Protect data - Uphold standards Updates Login <form action="dologin.php"> Password <input type = "text" name="pw"> <input type = "submit"> </form> </body> </html> HTML tags are not case sensitive Correct answer only <u>Examiner's Comments</u> Generally well answered and many candidates gained full marks with most being able to gain at least two.

Question			Answer/Indicative content	Marks	Guidance

		ii	• h1 and other code contained in { }
			• color :white;
			• background-color : red;
			//background: red;
				3	Ignore presence or lack of <style> tags. Ignore lack of semicolons
					
					Penalise misspelling of "color" once and then FT
					
					h1 {
					color:white;
					background-color: red;
					}
					
					White can be #FFFFFF or #FFF
					Red can be #FF0000 or #F00
					
					<u>Examiner's Comments</u>
					
					Many candidates were able to gain full marks. The most common reasons candidates lost marks was through the use of quotes around the colour equals instead of colons and for misspelling colour

	c	i	• <u>Copyright Designs and Patents Act</u> Any two from: • Gives the author (the programmers)ownership/copyright of the photographs • …no need to apply // this is automatic • Others cannot use/distribute // can beprosecuted/fined for using/distributing… • …without permission • Permission can be granted / bought / licenced	3	Must be full name of Act for MP1 FT for versions of Copyright or nothing for MP2-6 <u>Examiner's Comments</u> Many candidates were able to gain 2 marks but many did not give the full name of the legislation.

Question			Answer/Indicative content	Marks	Guidance
		ii	• Ask permission of **author / photographer /owner** • Use images marked as copyright free (e.g.Creative Commons Licence) • Purchase (licence to use) image	2	Do not accept just "ask permission" Examiner's Comments Many candidates were able to gain 2 marks. It was surprising to see how many believed that you could use copyright images for your business just by crediting the artist. Candidates should be made aware that although crediting the artist may help avoid plagiarism it does not allow you free use of a copyright image.
			Total	**22**	

Question			Answer/Indicative content	Marks	Guidance
3		i	e.g. • Share hardware (e.g. printers) • Share files • Share Internet connection • Centralised security • Log on / access files from any machine on the LAN • Central maintenance • Central backup / storage • Central installation / update of programs • Can monitor user activity • Can control access levels // Centralised useradmin • Access an intranet	3	Mark first answer in each answer space <u>Examiner's Comments</u> This question challenged many candidates who were unable to give three advantages to the business and instead gave 3 benefits of a LAN over a WAN which was not what the question required. The candidates who did manage to gain full marks were able to give clear advantages to a business of having their machines networked in a LAN.  **OCR support** Link to a resource for features of a computer network can be found in this document on TeachCambridgehttps://teachcambridge.org/item/01e01b94–6f2e-4afa-a765-c11b94aca292
		ii	• A set of rules // an agreement • Used to ensure the (proper / successful) **transfer of data** between devices // used to govern the **transmission / communication** between devices • May specify format of data / error checking / etc	2	Allow suitable example of contents of a protocol for MP3 Do not award a rule - must be plural <u>Examiner's Comments</u> This was generally well answered and many candidates were able to gain both marks

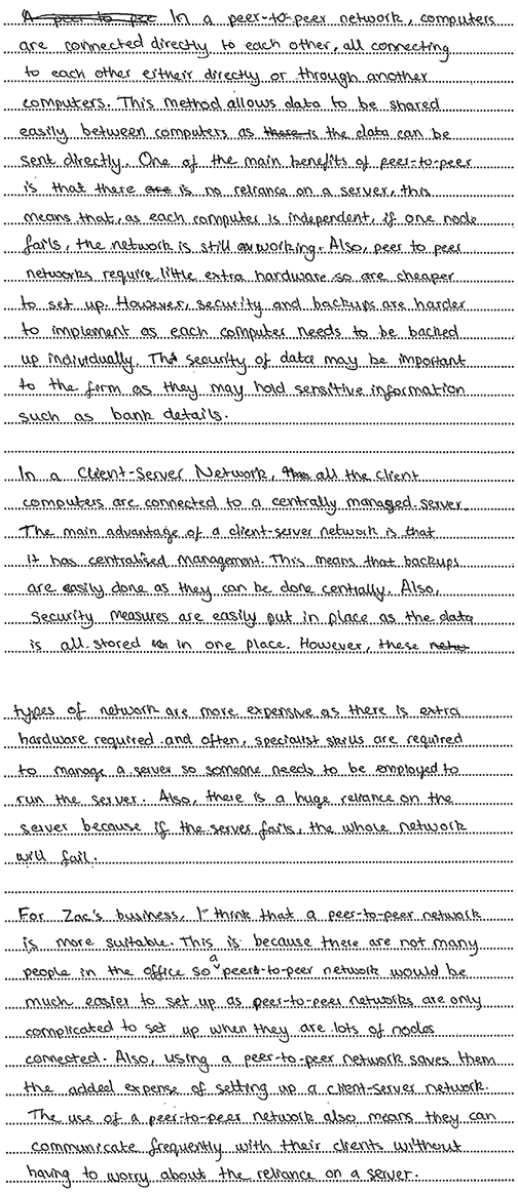
Question			Answer/Indicative content	Marks	Guidance
		iii	1 mark per protocol listed e.g. • HTTP // Hypertext Transfer Protocol • HTTPS // Hypertext Transfer Protocol Secure • TCP // Transmission Control Protocol • IP // Internet Protocol • UDP // User Datagram Protocol • FTP // File Transfer Protocol • Ethernet • WPA // Wi-Fi Protected Access • DHCP // Dynamic Host Configuration Protocol • SMTP // Simple Mail Transfer Protocol • POP // Post Office Protocol • IMAP // Internet Message Access Protocol • RDP // Remote Desktop Protocol • VoIP // Voice over Internet Protocol	2	Mark first answer in each answer space If mentioned one protocol with 2 versions e.g. IPv4 & IPv6 - only 1 mark If they've written the protocol in full but got any word wrong, no mark awarded <u>Examiner's Comments</u> Generally well answered and it was interesting to see the different protocols candidates were able to name. Some candidates named two of the layers in TCP/IP instead of protocols which gained them no marks.

Question			Answer/Indicative content	Marks	Guidance
		iv	• To apply protocols in order / one after the other • To provide independence of layers // Layers can be modified without affecting other layers // Layers are self-contained • Hides details from previous or next layer(s) // is an abstraction • Each layer is well defined / does a specific job • Breaks tasks down into manageable units // Groups similar protocols together • Improved troubleshooting (easier identification of the layer that causes the issue) • Each layer only communicates with adjacent layers// simplifies interfacing • Hardware/software can be manufactured to fit into one specific layer • Allows for standards for individual tasks/layers to be developed // for compatibility	3	Examiner's Comments Protocol layering has appeared in questions in previous papers, but many candidates were not able to explain why they are layered. Some candidates gave a description of the layers in TCP/IP without saying why it was layered.
			Total	10	

Question			Answer/Indicative content	Marks	Guidance
4	a	i	◦ In circuit switching dedicated hardware resources are used for each connection ◦ In packet switching hardware is used for multiple different connections. ◦ In circuit switching the data is sent along one route/stream. ◦ In packet switching packets of data may be sent along multiple different routes/packets may not be in order • Circuit switching is less secure if data is intercepted • Packet switching, data is more secure if intercepted/not all packets will be intercepted	AO1.2 (2)	Marks answers in pairs <u>Examiner's Comments</u> Many candidates achieved both marks for this question with most of the responses describing the different routes taken by the data. The candidates who did less well on this question did not understand differences between packet switching and circuit switching.
		ii	• Computer networks would involve multiple connections happening concurrently • In packet switching hardware is not tied up with each unique connection // can handle multiple connections simultaneously • Computers pass vast amounts of data which may encounter transmission errors • Packet switching means only resending individual packets instead of the whole data stream • Computers may be transmitting business critical data • Packet switching means any network hardware failures can be mitigated by routing around it.	AO2.1 (2)	<u>Examiner's Comments</u> Many candidates lost marks for the second part of Question 6 (a) (ii), despite achieving both marks for the first part 6 (a) (i). A lot of incorrect answers gave a very similar response to the first part of the question instead of explaining why the differences that packet switching has, make it more suitable for a computer network. Common correct answers explained that packet switching can route around hardware failures as the data is not sent along a single route.

Question			Answer/Indicative content	Marks	Guidance
	b		**Mark Band 3–High Level** **(7–9 marks)** The candidate demonstrates a thorough knowledge and understanding of both peer to peer and client server and can give valid application of both in this scenario. All detail are generally accurate and relevant. 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. *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 client server and peer to peer; the material is generally accurate but at times underdeveloped. The candidate may not have applied both to this scenario. 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. *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	AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	AO1 P2P: • Each computer can act independently • Each computer is responsible for it's own security and login • Each computer will maintain and possibly share its own connected hardware (printer/external storage/internet connection) • Each computer will maintain and possibly share its own secondary storage • If a computer is powered down it's shared resources will not be available. • There are no resources not shared by a peer machine • Adding a machine is simple • Very little administration is needed Client Server: • All network functionality can be provided by servers. • A server is a process running on a machine, usually dedicated to providing these services. • A server machine is designed to never be powered down. • Login/security is handled centrally • Shared storage may be managed by a server • Shared resources (printer/internet connection etc) my be managed by a server • If a server process or machine fails, network functionality, including the ability login is lost • Adding a new machine can mean installing specialist client software and setting up OS policies. • IT skills and a lot of time are needed to administer a client server

Question	Answer/Indicative content	Marks	Guidance
	knowledge of client/server or peer to peer and has made some attempt at applying this knowledge. 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 an unsupported assertion. *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.		network AO2 P2P: • As Zak is looking to expand his staff, P2P would offer flexibility in adding staff ad hoc. • Zak's company is still small and may struggle to pay for the IT administrator skills needed for a client server Client Server: • As Zak's firm is an accountancy firm it will have sensitive customer data • Client server would allow stronger centralised security • As Zak is taking on multiple staff, they may wish to work collaboratively, which shared storage would allow. • Zak could share a single printer/other hardware with all staff and not worry about an individual computer being switched on. AO3: Candidates can conclude either method, but to score in the top MB must have a clear line of reasoning to justify their choice. <u>Examiner's Comments</u> Candidates were assessed on the quality of their extended response in this question. Although most candidates were able to give a few advantages and disadvantages of the different types of network, few made suitable links to the scenario. Some candidates discussed different

Question	Answer/Indicative content	Marks	Guidance
			topologies which was not relevant to the question. Candidates that were given high marks for this question focused more on the scenario, and made clear links between this and the benefits and drawbacks of the different solutions. Exemplar 3  ~~A peer to peer~~ In a peer-to-peer network, computers are connected directly to each other, all connecting to each other either directly or through another computers. This method allows data to be shared easily between computers as ~~there~~ is the data can be sent directly. One of the main benefits of peer-to-peer is that there are is no reliance on a server, this means that, as each computer is independent, if one node fails, the network is still ~~an~~ working. Also, peer to peer networks require little extra hardware so are cheaper to set up. However, security and backups are harder to implement as each computer needs to be backed up individually. The security of data may be important to the firm as they may hold sensitive information such as bank details. In a Client-Server Network, ~~the~~ all the client computers are connected to a centrally managed server. The main advantage of a client-server network is that it has centralised management. This means that backups are easily done as they can be done centrally. Also, security measures are easily put in place as the data is all stored ~~on~~ in one place. However, these ~~networks~~ types of network are more expensive as there is extra hardware required and often, specialist skills are required to manage a server so someone needs to be employed to run the server. Also, there is a huge reliance on the server because if the server fails, the whole network will fail. For Zac's business, I think that a peer-to-peer network is more suitable. This is because there are not many people in the office so ~~a~~ peer-to-peer network would be much easier to set up as peer-to-peer networks are only complicated to set up when they are lots of nodes connected. Also, using a peer-to-peer network saves them the added expense of setting up a client-server network. The use of a peer-to-peer network also means they can communicate frequently with their clients without having to worry about the reliance on a server. The candidate response is well structured. The candidate has firstly

Question			Answer/Indicative content	Marks	Guidance
					highlighted how the computers are connected for each type of network and discussed the advantages and disadvantages. The advantages and disadvantages are well balanced and there are clear links to the scenario throughout. The candidate has made a recommendation on the most suitable type of network for the scenario, highlighting the key advantages and showing clear reasoning. The conclusion emphasises the key points and gives a clear justification.
			Total	13	

Question			Answer/Indicative content	Marks	Guidance
5		i	• Protocol to be used is decided based on the application • E.g. HTTPS **for browser based service** // SMTP/IMAP **for messaging service** • Adds encryption • Passes on <u>to</u> transport layer to **send** • Gets data <u>from</u> transport layer **when receiving** • Unpacks message ready for display // removes headers or other non-viewable data • Decrypts message	5	For BP2, don't allow HTTP (question mentions encryption). Don't allow a list of protocols which aren't relevant to the question. Don't allow a protocol without its use <u>Examiner's Comments</u> Very few students could explain what happens at the application layer and answers tended to be about splitting data into packets. Some candidates did mention that encryption would take place but didn't go on to mention decryption when receiving data. Those candidates that identified that protocols are applied here were unable to give a specific example and simply listed protocols they knew, but without context.
		ii	• Receives (layered) data <u>from</u> internet layer **to send** • MAC addresses are added to the packet • Passes and receives data across wireless network (to WAN / other machine) • Passes (layered) data back up <u>to</u> internet layer **when receiving**	2	Wireless access given in question stem <u>Examiner's Comments</u> Very few candidates were able to gain 2 marks on this question. Some candidates talked about transmitting data via cables, despite wireless being mentioned in the question.
			Total	**7**	

Question			Answer/Indicative content	Marks	Guidance
6	a	i	• (Committed) data/transaction is not lost… • …in case of power / system failure	2	
		ii	• Completed transactions stored in secondary storage // data not stored long-term in RAM/cache	1	
		iii	• The outcome of concurrent transactions is the same as if transactions were completed sequentially. • Record locking allows one user/process to access/modify record level data at any one time • So data that is being used elsewhere cannot be modified // data that is being modified elsewhere cannot be used	3	Allow reference to lost updates/dirty reads/phantom reads for BP3. <u>Examiner's Comments</u> For candidates with a good understanding of ACID, these questions were well answered. Unfortunately, some had only a vague knowledge or confused it with referential integrity. Some answers were unclear. Some candidates talked about locking the entire database when record locking rather than just the relevant records.
		iv	• Can cause delays (as users wait for access) • Can cause deadlock	1	<u>Examiner's Comments</u> Many candidates were given a mark for deadlock or longer wait times. Those candidates given a mark in Question 2 (d) (iv) tended to be those who has gained marks in Question 2 (d) (iii).

Question			Answer/Indicative content	Marks	Guidance
	b		• 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.
	c	i	• Field that is unique/does not repeat	1	
		ii	• **Foreign Key:** PackageType • **Table Name:** Membership	2	Must be spelled correctly Examiner's Comments Many candidates gained 1 mark for the foreign key and most gained both marks, although some candidates gave 'package' as the table where it is a primary key rather than the membership table where it is the foreign key.
		iii	• Float / Floating Point / Real	1	Allow currency/double/single/decimal
		iv	• Adverts	1	CAO

Question			Answer/Indicative content	Marks	Guidance

	d		• Username and FirstName fields (and no others) selected correctly using SELECT keyword
			• Membership / both tables correctly selected using FROM keyword
			• Tables joined using correct JOIN / INNER JOIN keywords // Tables joined using correct WHERE clause
			• Fields use table identifiers before them
			• WHERE clause used to correctly show only records where Adverts = true
				5	For full marks, a fully correct working answer must be provided. Candidates can join tables in either of two valid ways (using JOIN or WHERE). Note that JOIN is given in the specification but INNER JOIN is also equally acceptable.
					
					BP1 is the same for either method
					For BP2, candidates can either choose just the Membership table **or** <u>both</u> the Membership and Packagetable
					BP3 credited for correct JOIN / INNER JOIN or correct use of WHERE clause to join tables. <u>Do not credit if FROM clause incorrect for this method</u>
					BP4 credited if candidates have used table identifiers before the field name (i.e they have used Membership.PackageType and not just PackageType)
					BP5 will require use of AND if WHERE is used to join tables.
					
					Spellings of all field names, table names and keywords must be accurate but only penalise once.
					
					<u>Example one using JOIN keyword</u>
					`SELECT Username, Firstname`
					`FROM Membership`
					`JOIN Package on Membership.PackageType=Package.PackageType`
					`WHERE Adverts = true`
					
					<u>Example two using WHERE clause</u>
					`SELECT Username, Firstname`
					`FROM Membership, Package`
					`WHERE Membership.PackageType = Package.PackageType`
					`AND Adverts = true`
					
					<u>Examiner's Comments</u>

Question			Answer/Indicative content	Marks	Guidance
					Many candidates were able to gain some marks. The question refers to the Adverts field which is in the package table and states that the data shown in the tables is only an extract from the tables. For full marks on this question, candidates were expected to attempt to join the two tables to access the Username and Firstname from the membership table, and the Adverts from the package table.
			Total	22	

Question			Answer/Indicative content	Marks	Guidance
7	a	i	1 mark for each completed row up to a maximum of 2 marks: Application **Transport** **Network** Link	2 (AO1.1) (2)	– Accept in any order – Accept Internet instead of Network Examiner's Comments Most candidates achieved both marks for this question. The order of the layers was not important to get both marks and many candidates gave "Transport" and "Network" as the two missing layers. Some candidates gave "Internet" in place of "Network" which was also acceptable.
		ii	1 mark per bullet up to a maximum of 2 marks, e.g: • Allows different layers to be worked on independently • Allows layers to be replaced/upgraded without affecting others • Allows for layers from different providers to be used interchangeably	2 (AO1.2) (2)	Examiner's Comments This question was generally not answered well. Candidates that did gain marks, focused on the concept of layers being independent. Many candidates missed this concept and did not achieve the marks. Candidates should be careful to use the correct terminology for questions of this type.
	b		• A set of rules (for communication)	1 (AO1.1) (1)	Do not accept instructions instead of rules Examiner's Comments This question was answered well.
			Total	**5**	

Question			Answer/Indicative content	Marks	Guidance
8		i	– Has no moving parts… (1) … less likely to be damaged / data loss (1) – Consumes less power… (1) …meaning battery needs recharging less often (1) – Unaffected by magnetic fields.. (1) – …which could lead to data loss. (1) – Faster access speed… (1) – …so photographs can quickly be written to it / browsed. (1) (Mark in pairs)	2 AO1.2 (1) AO2.1 (1)	<u>Examiner's Comments</u> Many candidates gave a reason for the advantage without stating the actual advantage e.g. 'flash storage has no moving parts' without going on to say, therefore the advantage is 'less likely to be damaged/lose data'.
		ii	– Lossy compression (1) Any 2 of the following, must be in context: – Some loss of detail is acceptable (1) – Unlikely to be noticeable (1) – Will make the file size smaller than lossless(1)	3 AO1.2 (1) AO2.1 (2)	Do not accept 'smaller' on its own, must be 'smaller than lossless'. Do not accept lossless compression as most appropriate. In this case give zero marks for the justification also. <u>Examiner's Comments</u> Candidates would be best advised to fully consider how they would justify their choice appropriately for the given scenario before committing to 'lossy or lossless'. Those who correctly chose 'lossy' went on to achieve at least one of the other two available marks.
			Total	**5**	

Question			Answer/Indicative content	Marks	Guidance
9			– Stands for “Transmission Control Protocol / Internet Protocol”… (1) – Protocol(s)/set of rules… (1) – …for communicating across a network / the internet. (1) – Each protocol belongs to a different layer. (1) – The layers are: Application, Transport, Internet, Link (1) – (Starting at the Application layer) data is further encapsulated as it as it is passed to the next layer. (1)	1 AO1.1 2 A01.2	Accept layers in any order. Accept Data Link instead of Link. Ignore any mention of Physical layer. Do not accept Network for Internet layer. MP3 is dependent on either MP1 or MP2 being awarded. <u>Examiner’s Comments</u> Most candidates achieve zero to two marks on this question. Explanations generally contained errors or omissions. A fundamental explanation would suffice for full marks e.g. ‘Transmission Control Protocol/Internet Protocol is a set of rules used for communicating across the internet’.
			Total	3	

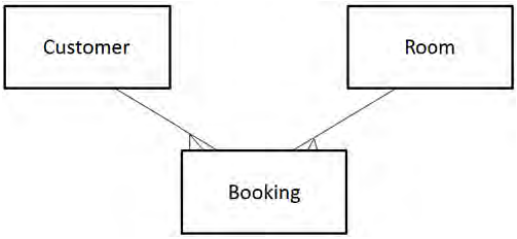
Question			Answer/Indicative content	Marks	Guidance
10			1. Creates / declares / defines a variable (called total) (1) and assigns it an empty / blank (string). (1) 2. A loop that iterates 200,000 times. (1) 3. - 4. Concatenates (the string version of) j to total. (1)	4 AO3.3	For point 1 accept 'blank value' for empty string For point 4 accept *add* instead of *concatenates* only if it is clear it is building a string and not adding a numeric value. Accept 'append'. Examiner's Comments In general, candidates did not use technical terminology when describing the effect of the code e.g. declaring a variable, assigning an empty string, concatenating strings. Centres should encourage candidates to use these and similar terms in response to questions where they are required to describe code.
			Total	4	

Question			Answer/Indicative content	Marks	Guidance
11	a	i	• Web crawler /spider visits site • Either be selecting it from an existing list or following a link. • Records information • …such as text / metatags / etc • Records the position of each word within the page • Storing them in an index • Follows links to other sites • Robots.txt file can be used to instruct web crawlers	4 AO1.1	
		ii	• A value between 0 and 1 • Probability that a user will not follow a link	1 AO1.1	
		iii	• Number of links to target site • PageRank score of those sites (linking inwards)	2 AO1.1	
	b		• HTML defines the structure of a web page • HTML defines the content of a web page • Using tags (enclosed in <>) • CSS defines the style / appearance • Using selectors such as classes / IDs / etc • Can be placed within HTML or externally in a file • Multiple pieces of CSS can be combined (the more local instances overriding)	4 AO1.1	Do not accept layout/format for HTML as this is too vague and can be used to describe CSS
			Total	11	

Question			Answer/Indicative content	Marks	Guidance
12		i	• Field with a unique value • CustomerID	2 AO1.2 (1), AO2.2 (1),	
		ii	• SELECT CustomerID, Surname • FROM Customer • WHERE Title="Miss" • OR Title = "Mrs"	4 AO3.2	1 mark per bullet point. Data in fields must be in speech marks/apostrophes Allow speech mark/apostrophe FT for BP 2 and 4 Ignore colons/semicolons
		iii	• Only one customer entry allowed (because of key field) • …so would not be able to add second entry • Customer data already present/would be repeated • ….resulting in redundant data/wasted space • …resulting in inconsistencies should changes be made	2 AO2.1	Mark in pairs.
		iv	• Add in second table • …for the cars // splitting up cars/customers • The primary key of customer is used as a field in the car/vehicle table • … as a foreign key of cars • Create one to many relationship. *Accept many to one*.	5 AO1.2	
			Total	13	

Question			Answer/Indicative content	Marks	Guidance
13	a	i	• Client computers connect to server • Server provides access to a resource/service • In this case hotel staff use client computers to connect to database on server (or other sensible example).	3 AO1.2	
		ii	e.g. • only one point of failure • easier to manage users/access • Easier to backup • Easier to keep data secure. • Technicians can more easily remotely install / monitor.	2 AO1.1	
	b		• Joins computers/devices together on a LAN • Receives packets/data • Recipient's address is given in packet header/it uses the mac address • Send packets/data • Out the correct port /to the specific computer device	3 AO1.1	

Question			Answer/Indicative content	Marks	Guidance
	c		**Mark Band 3–High Level (7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of network security. 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 network security; 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.	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	AO1 Malware and viruses are software that can have a negative impact on computer systems Spyware and keyloggers can record information entered and send back to a third party Phishing attacks attempt to steal data by fraudulently appearing as legitimate emails asking for secure information Denial of Service Attacks can overload a computer system with traffic and effectively disable access for legitimate users AO2 Hotel's systems could be disrupted by DDOS attacks so no external bookings able to be made. Phishing and spyware attacks may compromise visitor security and result in financial loss Malware, viruses could destroy hotel data Theft of customer data would be an issue under Data Protection Act / GDPR for which the hotel could be prosecuted AO3 Education for staff and customers is important to deal with recognising and dealing with threats Up to date software, limitations of use of devices such as USB sticks and restricted access to wireless networks can all limit risks. Use of Firewall to restrict traffic entering and leaving the network. Should be balanced against customer experience; will customers return if they have no access to It facilities?

Question			Answer/Indicative content	Marks	Guidance
			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 network security; 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 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.		
	d	i	-Customer, Room and Booking entities, must be singular -Customer joined to Booking and Room joined to booking and no other links -Customer to Booking relationship indicated as one-many -Room to Booking relationship indicated as one-many	4 AO2.2	
		ii	• A field that links to a (primary) key in a second table • Example : Customer ID // RoomID… • … in Booking table	3 AO1.1 (1) AO2.1 (2)	

Question			Answer/Indicative content	Marks	Guidance
		iii	• Hashing for security • …e.g. hash passwords in database • …to make sure they cannot be read if they are stolen • Hashing for direct access • …e.g. Customer/Room/Booking records can be quickly accessed • …by using hash of index as address	4 AO1.2 (2) AO2.2 (2)	
	e		• Database/relationships are consistent // each foreign key links to an existing/valid primary key • Suitable example of being broken (e.g. if primary key is deleted/updated, foreign keys are no longer valid / changes should be cascaded)	2 AO1.1 (1) AO1.2 (1)	Accept example that is not related to the database given (as this is an AO1 question)
			Total	30	

Question			Answer/Indicative content	Marks	Guidance
14			**Mark Band 3–High Level** **(7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of networking methods and cost and security implications. 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 evaluate different methods of network and how they would be beneficial to the business and come to a reasoned conclusion. *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 networking methods and cost and security implications and is able to talk about some of the attributes of each; 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 explain how different aspects of networks would be beneficial to the business however they may not always be accurate. They will come to a conclusion although their	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	**Knowledge** • As firm is on multiple sites it will need to be connected via a WAN • Each office would have its own LAN • Use of Client/Server network which will allow ◦ Centralised security ◦ Centralised back up ◦ Shared resources such as file/print/internet are not tied to a peer computer ◦ Extra hardware for client/server would incur extra expense • VPN would allow secure access to server in one site from another • Cloud computing would allow remote storage of data ◦ Would allow sharing of data between sites and client locations ◦ Provide extendable storage ◦ Built in back up ◦ Strong security, but out of firms control • Network would allow data and resources such as printers to be shared ◦ Sharing resources would allow solicitors easier access to client files ◦ Even with strong security, networks bring vulnerability to sensitive data being held **Application** • As a solicitor's firm will deal with sensitive data security concerns would be paramount to clients who have data stored with them ◦ Use of VPN may be necessary to provide secure links between offices ◦ Data would need to be

Question			Answer/Indicative content	Marks	Guidance
			justifications may not be clear. *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 networking methods and cost and security implications and may be able to recall the attributes of one or more with limited understanding shown; 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 has some explanation of the benefits or drawbacks to the business although the accuracy may be limited and their conclusions not clear *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.		encrypted ◦ Clients may be unhappy with external services such as cloud ◦ Strong security measures would bring extra cost, which could push fee's up • Client server set up would require extra equipment ◦ Switches/routers/gateways/ servers/NIC/cabling/ WAP ◦ Extra costs may push fee's up • A network would give solicitors quicker/immediate access to client files ◦ Allows solicitor to quickly switch between clients ◦ Allow solicitors to collaborate and help colleagues ◦ Allows clients to be seen by solicitors at either office and they would sill have access to their case files ◦ Allows solicitors to research old cases from either office **Evaluation** The candidate could come to either a conclusion of the network being an overall drawback or benefit. However, their reasoning must clearly lead to that conclusion with clear justification.
			Total	9	

Question			Answer/Indicative content	Marks	Guidance
15			– A transaction / review can only fully complete or not complete / cannot partially complete – In this case, it should not be possible for the review to be added without the (average) rating being updated. (1 mark per -, max 2)	2 AO1.1 (1) AO2.1 (1)	<u>Examiner's Comments</u> This question was generally well attempted by most candidates. Those who did not gain credit referred to atomic being the lowest level of detail which is incorrect in this context.
			Total	2	