Mark scheme

Question			Answer/Indicative content	Mark	Guidance
1	a		1 mark per bullet to max 2: 1 mark for: • A set of rules for communication/ transmission/transfer of data between devices 1 mark **max** from: • The sending system has no direct control over the way the receiving system responds • Allows standardisation as different devices have different OS/hardware • Protocols allow for data to be exchanged in a predictable way/ in the correct format	2	Not '**a** rule' - must be plural MP1 not a set of **instructions** MP1 accept **standards / an agreement** **Examiner's Comments** Most candidates were able to explain that a protocol is a set of rules for communication between devices. Few then went on to explain what that meant and so the majority of candidates gained one mark.
	b		1 mark for hardware and 1 mark for expansion to 6 marks max • **Router** e.g. • Connect networks together • Assign IP address to devices • Examines data packets and forwards them • **Cable/ Ethernet** e.g. • Carries digital data from one device/NIC to the next • Connects wired devices to the network	6	2 marks max each. Allow any suitable expansion. Mark in pairs. Allow: **Proxy server** e.g. • Sits between user and computer to route requests through an external server • Creates separation between a user and the site/service • Protects your security/anonymity by hiding IPs **Examiner's Comments** The majority of candidates could give three different pieces of networking hardware but many were unable to

			• **Gateway** e.g. • Connects different types of network • Translates protocols from one network to another • **Bridge** e.g. • Connects different network segments • **Repeater** • Receives a signal and retransmits it • **Network Interface Card / NIC** e.g. • Gives each device a MAC address / unique ID • Allows a computer system to interface with a network • **Wireless Access Point / WAP** e.g. • Allows wireless devices to communicate with each other • Sends and receives radio waves • Examines data packets and forwards them • **Switch** e.g. • Connects multiple wired devices to the network • Receives data and forwards it to the intended recipient • Examines data packets and forwards them • Routes based on MAC addresses • **Hub** e.g. • Receives data from a device and broadcasts it to **all**		then describe what they did with many putting connects devices for the description of each piece of hardware.

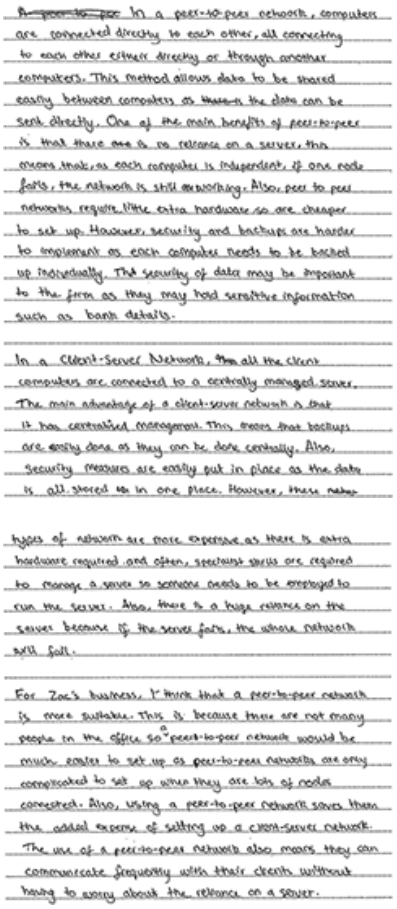
			devices connected to it • **Modem** e.g. • Changes a signal from digital to analogue • **Firewall** e.g. • Filters traffic coming in and out of a network		
			Total	**8**	
2		i	e.g. • Share hardware (e.g. printers) • Share files • Share Internet connection • Centralised security • Log on / access files 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 **Examiner's Comments** 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 **Examiner's Comments** This was generally well answered and many candidates were able to gain both marks

		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 **Examiner's Comments** 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.
		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	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.

			/ 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		
			Total	**10**	
3	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	AO1.2 (2)	Marks answers in pairs **Examiner's Comments** 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.

			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		
		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)	**Examiner's Comments** 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.
	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	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)

			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 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		• 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 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.

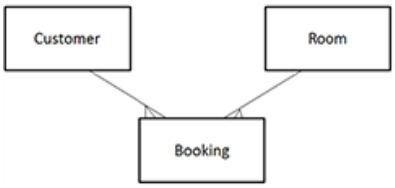
			acquired knowledge and understanding to the context provided. The candidate provides nothing more than an unsupported assertion. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 mark** No attempt to answer the question or response is not worthy of credit.		**Examiner's Comments** 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 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~~ the data can be sent directly. One of the main benefits of peer-to-peer is that there are ~~a~~ no reliance on a server, this means that, as each computer is independent, if one node fails, the network is still functioning. 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 clients 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 ~~in~~ in one place. However, these ~~other~~ 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 Zoe'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 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**	
4		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**	
5	a		• A set of rules (for communication)	1 (AO1.1) (1)	Do not accept instructions instead of rules **<u>Examiner's Comments</u>** This question was answered well.
	b	i	1 mark for each completed row up to a maximum of 2 marks: Application	2 (AO1.1) (2)	– Accept in any order – Accept Internet instead of Network

			<table><tr><td>Transport</td></tr><tr><td>Network</td></tr><tr><td>Link</td></tr></table>		**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.
			Total	**5**	
6	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	3 AO1.1	

			• 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		
	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	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?

			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 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	4 AO2.2	

			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		
		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)	
		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**	
7			1 mark per bullet up to a maximum of 4 marks • DNS is used to resolve IP corresponding to URL	4 AO1.1 (2) AO1.2 (2)	Award the mark for checking of cache at any of the stages but limit to one mark for this aspect.

			• Request sent to DNS resolver. • Resolver checks its cache and if it doesn't hold the URL, it passes it in to the TLD Name server which checks its cache and returns the answer or passes on to the.. • Authoritative Name Server. • The IP address is returned back up to the requesting client. • Or an error if no resolution can be found.		
			Total	**4**	
8			**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	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 o Centralised security o Centralised back up o Shared resources such as file/print/internet are not tied to a peer computer o 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 o Would allow sharing of data between sites and client locations o Provide extendable storage o Built in back up o Strong security, but out of firms control • Network would allow data and resources such as printers to be shared o Sharing resources would allow solicitors easier access to client files o Even with strong security, networks bring vulnerability to sensitive data being held **Application**

			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 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
					• 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 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.

			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.		
			Total	**9**	