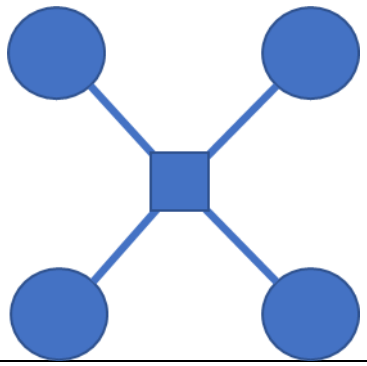
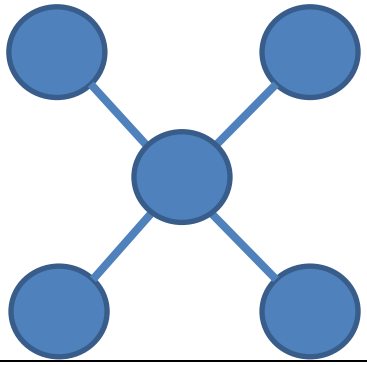
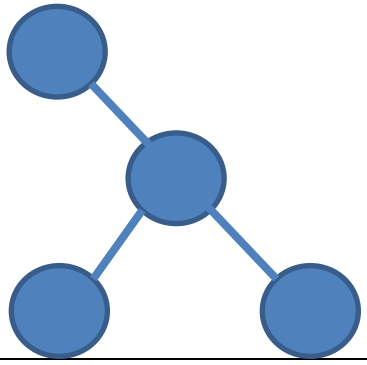
01	1	**4 marks for AO1 (understanding)** **1 mark** for each explanation point. **Example answers** • A WAN is a Wide Area Network that links more than one remote geographical site/location to another; • A LAN is a Local Area Network that links together devices that are within one site\location; • The speed of data transmission across a LAN is likely to be higher than across a WAN; • WANs are typically public networks (and so data encryption is likely to be used); • LANs (may not need data encryption) as they are typically private; • LANs typically carry less traffic than WANs; • This is because the number of users on a LAN can be controlled by the administrator whereas public WANs could have an unlimited number of users; • LAN Connections are generally more reliable as they are under the control and maintenance of the network administrators; • On a WAN it is possible that heavy traffic, peak usage times, viruses, weather or physical damage could affect the connection reliability; • WANs are typically under shared ownership; • LANs are typically owned by a single person or organisation; • LANs use different protocol suites (accept protocols) to WANs; **R**. Simple expansion of acronyms. **R**. Any reference to cost comparisons. **R**. Reference to cable types. **R**. WAN is a collection of LANs/LANs joined together (if only a simple statement).	4

01	2	**Mark is for AO1 (understand)** **Max 1 mark** for any of the following: • HTTPS is secure/encrypted; • Data transmitted using HTTP could be easily read if intercepted; • Data transmitted using HTTPS can only be seen/read/understood by the (intended) recipient;	1

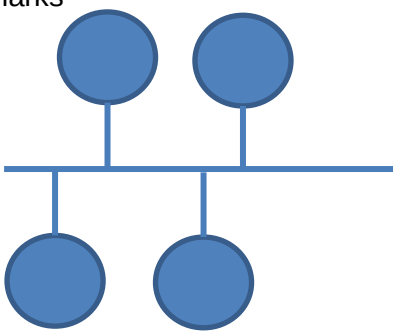
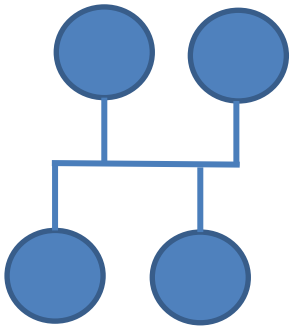
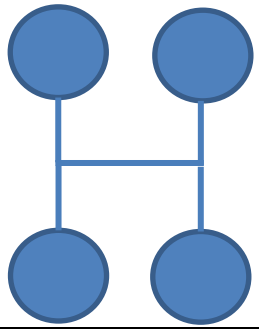
01	3	**2 marks for AO1 (recall)** **1 mark** for each correct answer. Accept any of: • Transport (layer); • Data Link (layer); • Link (layer); • Network Interface/access (layer) **R.** Any name that is not correct. **I.** the order that the answers are written in	2

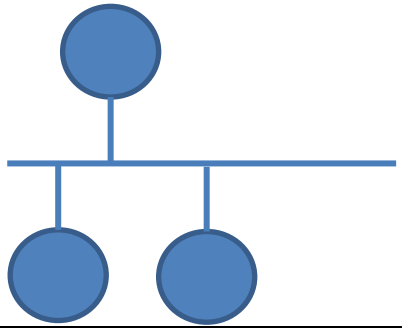
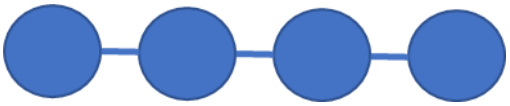
01	4	**2 marks for AO1 (understanding)** Max 2 marks: • packages/unpackages data (for/after transmission); • adds address(es) (for transmission); • routes the packets (across the network); • provides error checking; **R.** It provides access to the Internet	2

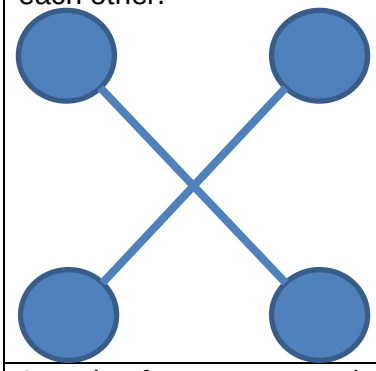
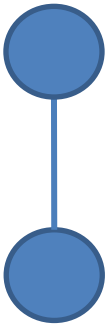
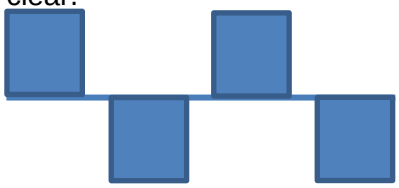
01	5	**2 marks for AO1 (understanding)** **1 mark** for each of the following points to a maximum of 2 marks. • Each device connected to the network has a (unique) reference ID/physical address (called the MAC Address); • There is a list of allowed/denied addresses; • The network device/router looks at the address of the device trying to connect (and blocks/allows appropriately);	2

02	1	**2 marks for AO2 (apply)** The diagram should clearly show that: • There are four or more computers/laptops/desktop computers in the diagram; • Each computer is **connected** only to a **central** hub/switch; **I.** other connected devices. **I.** representation/symbol used for computer or hub/switch. Examples: 2 marks  2 marks  1 mark 	2

02	2	**2 marks for AO2 (apply)** The diagram should clearly show that: • There is a **central** bus • All computers are **individually** connected to a single central bus • There are four or more computers/laptops/desktop computers 2 marks for **all three** points, 1 mark for **one or two** of the three points. **I.** Representation/symbol used for computer. **I.** Other connected devices. Example answers:	2

2 marks 	2 marks 
2 marks 	

1 mark – central bus and three computers connected 	1 mark – four computers, no bus indicated, connections are between machines and not onto a bus. 

		1 mark – four computers, no bus, computers connected directly to each other. 	**R**: insufficient computers and not clear that a bus is present. 
		1 mark – four computers, bus is not clear. 	

02	3	**2 marks for AO1 (understanding)** 1 mark for each point to a maximum of 2 marks. • Less likely to experience transmission errors/data traffic problems (contention issues); • Faster transmission of data; • A faulty connection only disables one computer (unless it's the hub/switch); • Fewer/no collisions (if a switch is used rather than a hub); • Better security (potentially as data is not broadcast to all machines if a switch is used); **R.** Easy to connect other devices.	2

02	4	**1 mark for AO1 (understanding)** 1 mark for any valid point. • It is more expensive to install (more cable required, more hardware needed); • It is harder to install (it requires more cable); • Switch/ hub/central device may fail (breaking the entire network);	1

02	5	**9 marks for AO1 (understanding)** **Sample guidance** **Benefits:** • Sharing of resources such as printers, storage space • Managed/central backing up of data • Central installation and management of software by network admin • Monitoring of users and network activity centrally by network admin • Hot desking/users can login to any machine • Ability to use communication tools between computers • Centrally managed access rights • Rapid data sharing • Allows decentralised/home working **Risks:** • Security of data – requires correct settings or anyone can see restricted data • Spreading of malware • Cost of infrastructure • Cost of network admin required to run network • Dependency on network hardware	9

Level	Marks	Description
3	7–9	The student has **explained all or discussed** some risks **and** benefits of using computer networks. A clear understanding of both is shown. Technical language is used accurately throughout the response.
2	4–6	The student has **described or explained** some risks **and** benefits. Some understanding is shown of both **or** a good understanding is shown of one. Some technical language is mostly used accurately in the response.
1	1–3	The student has **stated or described** some risks **or** benefits. Little understanding is shown of either. Technical language is never/rarely used and where present may lack accuracy.
0	0	Nothing worthy of credit.

02	6	**2 marks for AO1 (recall)** A set of rules; that allow devices/networks to communicate/transfer data;	2

02	7	**2 marks for AO1 (recall)** **C** IMAP**;** **D** SMTP**;** **If more than two lozenges shaded then marks are not awarded.**	2

03	1	**2 marks for AO1 (understanding)** **Max 2 marks** for one of the points below well explained **OR** two points stated from the list below. • It prevents unauthorised access into the network (by checking IP/MAC address/packet content); • It prevents unauthorised transmissions from inside the network to external locations; • It monitors network traffic; • It makes sure that only the right/authorised traffic is allowed; • It opens/closes ports as necessary; **R.** Prevents unauthorised users accessing network. **R.** Prevents access to unauthorised websites.	2

03	2	**3 marks for AO1 (understanding) and 3 marks for AO2 (apply)** 2 marks per method, 1 mark for stating the method, 1 mark for an explanation. • Passwords; a set of characters that is only known by the person who is being authenticated// a set of characters that is entered and compared against a database/recorded version; • Biometric; measures such as fingerprint, facial, iris, voice-print that use the user's physical features to prove who they are; • Email confirmation; sends an email which requires a valid email address and for the recipient to respond to prove the email and hence user is valid; **A.** Other methods that are not in the specification that are appropriate should also be awarded marks. Examples such as 2 Factor Authentication (2FA), Authenticator Apps, security questions.	6

03	3	**4 marks for AO1 (understanding)** Maximum of 3 marks if only1 type of testing. **Black box testing:** • the tester does not know how the system operates; • the tester is acting as an external hacker; • requires a lot of investigation and guessing/brute-force to find issues; • may not test all of the system especially if you do not know it's full functionality; • you are trying to discover and exploit the weak spots in the system; **White box testing:** • the operation of the system is known; • the tester is simulating a malicious insider; • can be targeted to test specific vulnerabilities; • you know exactly what you are trying to test; • because you know what you are testing you should be able to test all possible scenarios; **R.** Any direct opposites. Statements such as "Black box has no knowledge of how the system operates. White box has knowledge of how the system operates." would be awarded only one mark.	4

04		**2 marks for AO1 (recall)** 2 marks for **all four** correct ;; 1 mark for **any two** correct ; **R. D**uplicate answers.	2

Definition	**Letter**
Addresses data for transmission	C
Sets up the communication between the two hosts	B
Where the network hardware is located	D
Where the user software, such as web browsers or email programs, operates	A

Qu	Part	Marking guidance	Total marks
05	1	**2 marks for AO1 (recall)** A **maximum of 2 marks** can be awarded. • a collection/group of computers; • connected/joined together; **A.** references to allowing the sharing of resources if context is correct	2

Qu	Part	Marking guidance	Total marks
05	2	**9 marks for AO1 (understanding)**	9

Level	Description	Mark Range
3	Responses at the upper end of the level will contain a **thorough discussion** of the advantages **and** disadvantages of **both** wired and wireless networks. The security of **both** types of network are compared in detail. The response is well structured and coherent. Responses at the lower end of the level will mostly contain **discussions**, but may also include some **thorough explanations**, of the advantages **and** disadvantages of **both** wired and wireless networks. The security of **at least one** type of network is explained in detail. The response is well structured and coherent.	7–9
2	Responses at the upper end of the level will contain detailed **explanations** of the advantages **and** disadvantages of **both** wired and wireless networks. The security of **at least one** type of network is **explained**. The response makes sense when read as a whole and a logical trail of thought is apparent. Responses at the lower end of the level will mostly contain **explanations**, but may also include some **descriptions**, of the advantages **and/or** disadvantages of **both** wired and wireless networks. The security of **at least one** type of network is **described**. The response makes some sense when read as a whole.	4–6
1	Responses at the upper end of the level will contain **descriptions** of the advantages **and/or** disadvantages of wired **and/or** wireless networks. The security of **at least one** type of network is **described**. The response makes some sense when read as a whole. Responses at the lower end of the level will include a few **statements** related to one or more of the required points. The response might be disjointed and without any cohesion.	1–3
No creditworthy material		0

Indicative Content

	Wired Network	Wireless Network
Advantages	• Connection speeds are typically faster • They typically have higher bandwidth • They typically have better security/fewer security risks	• Typically lower setup costs • No wires/cables are required • It is easy to connect new devices • Users not confined to a single location // Users can connect to the network as long as they are within range • Can connect multiple devices without the need for extra hardware
Disadvantages	• Cables can be hazardous and unsightly • Not all devices can connect via cable eg some tablets • Can be expensive to set up	• Connection speeds can be slower • Connection speeds can reduce the further from the WAP you are • They can be subject to interference from walls, objects and other nearby electronic devices • They are typically less secure • Connections are not as stable as wired networks and can 'drop off'
Security	• Typically more secure than wireless as need physical access to the network to intercept data	• Risk of theft of bandwidth by neighbouring users within range • Risk of data loss/data being stolen unless encryption is used • Typically easier to intercept data/'hack' network // Wireless transmissions can be intercepted by anyone within range of the router

Qu	Part	Marking guidance	Total marks
05	3	**4 marks for AO1 (understanding)** A **maximum of 4 marks** can be awarded. Award **1 mark** for each correct tick. **R.** Any row that contains more than one tick.	4

Network Protocol	Application layer	Transport layer	Internet layer	Link layer
HTTP	✓			
UDP		✓		
IP			✓	
IMAP	✓			

Qu	Part	Marking guidance	Total marks
06	1	**Mark is for AO1 (recall)** Maximum of **one** mark from: • Bluetooth; • Near-field Communication/NFC; • IrDA/Infrared; • Zigbee; • Wireless USB; • Ultra-wideband/UWB;	1

Qu	Part	Marking guidance	Total marks
06	2	**2 marks for AO1 (understanding)** Maximum of **two** marks from: • LANs cover relatively small geographical areas // WANs usually cover a wide geographic area; • LANs often owned and controlled/managed by a single person/organisation // WANs often under collective/distributed ownership; • WANs are (usually) several LANs connected together; • WANs (usually) have a much larger number of devices/users than LANs; • LAN has a lower latency // WAN has higher latency; • WANs are (usually) slower than LANs; • the cost-per-byte for transmission is much higher on a WAN; • LANs and WANs use different protocols;	2

Qu	Part	Marking guidance	Total marks
06	3	**3 marks for AO1 (understanding)** Maximum of **three** marks from: • flexibility to expand network/add users/add own devices to the network; • there is no need to drill holes/install cabling; • mobility of user/devices; • modern devices are more likely to (be designed to) connect wirelessly; • guest access; • no trip hazards; **A.** cost if valid explanation given	3

Qu	Part	Marking guidance	Total marks
06	4	**Mark is for AO1 (recall)** **C** SMTP; **R.** if more than **one** lozenge shaded	1

Qu	Part	Marking guidance	Total marks
06	5	**2 marks for AO1 (recall)** Maximum of **two** marks from: • sending/receiving web pages; • using an encrypted connection // provides an encrypted version of HTTP; • more secure web transactions; • authentication of the website being visited; • encryption of the data between the server and the client; • reduces likelihood of man-in-the-middle attacks;	2

Qu	Part	Marking guidance	Total marks
07	1	**2 marks for AO1 (understanding)** **Maximum of 2 marks** from: • PAN centred round a person / up to 10 metres, WAN is (spread) over a large area; **NE** personal on its own • PAN and WAN use different protocols (**A.** examples); • PAN (typically) has one user, WAN has many users; • PAN connects a few devices, WAN connects many devices; • PAN owned by one person; WAN owned / managed by multiple large organisations; **Both PAN and WAN must be referred to (accept implicit comparisons) for each mark.** eg WAN connects more devices (the more acts as an implicit comparison).	2

Qu	Part	Marking guidance	Total marks
07	2	**2 marks for AO1 (recall)** **C.** LANs are usually controlled or owned by a single organisation. **E.** LANs cover one room, building or site. **R.** if more than two lozenges shaded	2

Qu	Part	Marking guidance	Total marks
07	3	**2 marks for AO1 (understanding)** **Maximum of 2 marks from:** • A bus network has all computers connected to a backbone / main cable, computers on a star network connect to a central device / switch / hub; • All devices / computers on a bus network see all data transmitted, on a (switched) star network the data is only seen by the intended device; • If the backbone / main cable on a bus network fails the whole network fails, on a star network a single cable breaking is unlikely to affect the whole network; • Bus backbone / main cable has a terminator at each end, network cards in star act as terminators; • Data collisions are less frequent on a star network;	2

Qu	Part	Marking guidance	Total marks
07	4	**2 marks for AO1 (recall)** (A set of) rules; that allow devices / networks to communicate / transfer data; **R.** instructions in place of rules	2

Qu	Part	Marking guidance	Total marks
07	5	**2 marks for AO1 (recall)** **1 mark** for each correct answer. • Internet (layer); • Link (layer) // Network interface (layer) // Network access (layer); **R.** Network Layer on its own	2

Qu	Part	Marking guidance	Total marks
08	1	**All marks AO1 (understanding)** **Reasons for allowing**: Teachers can access resources on the school network to allow them to plan lessons at home; Teachers can teach lessons from home (using videoconferencing) if they are not able to get into work (eg travel difficulties); Teachers can access electronic copies of student work so that they do not have to carry marking home; **Reasons for not allowing:** Data protection issues – schools may not want potentially sensitive student information to be accessed outside of school; To try to help teachers have a work-life balance; Increased security risks as teachers may not have fully-protected computers at home (eg if a teacher does not have anti-virus software on their home computer this may cause problems when they connect their computer to the school network); **Max 1 mark:** if only described reasons for allowing access **Max 1 mark:** if only described reasons for not allowing access	2
08	2	**All marks AO1 (understanding)** Share hardware; **A.** by example Share data/files; Easier to work collaboratively; Use of communication tools Central management for machines **A.** by example: centralised software deployment, centralised back-ups; Files not stored on local machine so can be accessed from multiple machines; Can monitor computer users; Increase available storage; **Max 3 marks**	3

Qu	Part	Marking guidance	Total marks
08	3	**1 mark for AO1 (understanding)** PANs are centred around one person, LANs cover a limited geographical area / LANs cover a larger area; PANs have one user, LANs (normally) have more than one user; PAN uses Bluetooth, LAN uses alternative protocols / connection methods (**A.** by example); **Note:** answer must cover both PAN and LAN to be awarded a mark **Max 1**	1
08	4	**1 mark for AO1 (understanding)** Wearable computing devices; Connecting headphones to a music player; Connecting pedometer to a mobile phone; **A.** any suitable example **Max 1**	1
08	5	**All marks AO1 (recall)** a set of rules; that allow two devices to communicate;	2
08	6	**Mark is for AO1 (recall)** **E** IMAP; **R.** If more than one lozenge shaded	1
08	7	**Mark is for AO1 (recall)** **B** HTTPS; **R.** If more than one lozenge shaded	1

<table>
<tr><th>Qu</th><th>Part</th><th>Marking guidance</th><th>Total marks</th></tr>
<tr><td>08</td><td>8</td><td>Mark is for AO1 (recall)

D SMTP;

R. If more than one lozenge shaded</td><td>1</td></tr>
<tr><td>08</td><td>9</td><td>All marks AO1 (recall)

<table>
<tr><th>Layer</th><th>Order (1-4)</th></tr>
<tr><td>Transport</td><td>2</td></tr>
<tr><td>Link</td><td>4</td></tr>
<tr><td>Network</td><td>3</td></tr>
<tr><td>Application</td><td>1</td></tr>
</table>
Mark as follows:
1 mark: any row correct;
2 marks: any two rows correct;
3 marks: all four rows correct;</td><td>3</td></tr>
</table>

Qu	Part	Marking guidance	Total marks
09	1	**All marks AO2 (apply)** Staff could forget their password // staff can't forget biometric measure; Shouldering risk when staff entering their password // no risk of shouldering when using biometric data; Lower risk of hacking; **Max 2**	2
09	2	**All marks AO2 (apply)** Network is made available to members of the public; Won't know the MAC addresses for (most) of the devices connecting to the network;	2

<table>
<tr><th>Question</th><th>Part</th><th>Marking guidance</th><th>Total marks</th></tr>
<tr><td>10</td><td>2</td><td>
6 marks for AO2 (apply)
<table>
<tr><th>Level</th><th>Description</th><th>Mark Range</th></tr>
<tr><td>3</td><td>Response demonstrates a sustained line of reasoning and contains a thorough discussion of the advantages and disadvantages to the school/staff/students of installing a network instead of standalone computers.

There is a structured discussion of the advantages and disadvantages of installing computers in a network and the response includes points that are clearly relevant to the context.</td><td>5–6</td></tr>
<tr><td>2</td><td>Response includes explanations of the advantages and/or disadvantages of installing computers in a network and is generally relevant to the school/staff/students. The response makes sense when read as a whole.

There is a structured consideration of the advantages and/or disadvantages of computer networks though some of the points made may not be wholly relevant to the context.</td><td>3–4</td></tr>
<tr><td>1</td><td>Response includes descriptions of the advantages and/or disadvantages of installing computers as a network with little reference to the school/staff/students.

There are a few statements related to one or more of the required points. The statements might be disjointed and without any cohesion.</td><td>1–2</td></tr>
<tr><td colspan="2">No creditworthy material</td><td>0</td></tr>
</table>
Indicative content
Advantages:
• folders and files (of staff/students) can be stored centrally and accessed by any authorised person
• peripheral devices (such as classroom printer) can be shared // Fewer peripherals required
• access to the Internet / communications can be shared
• central management of resources / software // cheaper licencing
• students/staff can have one account that can be accessed on any networked computer
• central backup of files (of staff/students)
• allows better monitoring of computer usage (of staff/students)
• allows staff to access school files from home
• students/staff can bring in own devices to connect to the network
</td><td>6</td></tr>
</table>

		• staff and students can change rooms and still have access to the network. Disadvantages: • difficulty of managing network (as it increases in size) • increase in potential cyber security issues when accessing staff/student records • server breakdown can prevent access to all connected devices // loss of work • viruses / malware can spread more easily • cost of cabling / servers • risk of malicious attack / hacking • speed can deteriorate as usage increases • reliance on network hardware (eg. switch) • cost of hiring network manager to maintain network • staff/students may require training on how to use network.	

Question	Part	Marking guidance	Total marks
11		**2 marks for AO1 (understanding)** SMTP: Sends emails (between servers); IMAP: Stores emails on a server; // Retrieves / receiving emails; // View and manipulate emails (as though stored locally); // Email displayed on client programs/devices;	2

Question	Part	Marking guidance	Total marks
12		**2 marks for AO1 (understanding)** (Encryption) scrambles the data (before transmission) // changes plaintext into ciphertext (before transmission); **NE** encrypts the data so it cannot be read/understood by unauthorised users/devices;	2