

THEME A: CONCEPTS · A2.3

Data transmissions — Mark scheme

34 marks · covers A2.3.1–A2.3.4

How to mark. Each creditworthy point is on its own line and ends with a semicolon (;). A line beginning with ... is an *expansion* of the line above it, so the pair is worth the marks shown. A slash (/) separates acceptable alternative wordings. Words in (brackets) are not needed for the mark. Mark positively: credit what the student has got right rather than penalising what is missing, and accept any valid alternative not listed here. Do not award more than the maximum for a part. Where a later part uses a wrong answer from an earlier part correctly, award follow-through marks (FT). HL marks parts that assess higher level only content.

Q	ANSWER	MARKS
1(a) A2.3.1	Award [1] max 32 (bits);	1
1(b) A2.3.1	Award [2] max Award [1] for the point and [1] for the expansion. IPv4 provides only about 4.3 billion addresses, which is not enough for the number of devices now connected; ...(so) IPv6 uses 128 bits, giving a vastly larger address space that will not run out; The shortage of IPv4 addresses forced the use of workarounds such as NAT; ...(so) IPv6 allows every device to have its own unique public address again; Also accept: a simplified header with 8 fixed fields rather than 14, or IPsec support being mandatory rather than optional.	2
1(c) A2.3.1	Award [3] max Award [1] per point up to [3] max. The contrast must be clear. A public IP address is unique across the whole internet, whereas a private address is unique only within its own local network; A public address is allocated by the internet service provider, whereas private addresses are assigned by the router from reserved ranges; The same private address can be reused on many separate networks, which is not possible for a public address; Data cannot be routed to a private address directly from the internet, so traffic must be translated at the router;	3
2(a) A2.3.1	Award [2] max Award up to [1] per difference, [2] max. A static address stays the same every time the device connects, whereas a dynamic address may be different on each connection; A static address is configured manually and reserved for that device, whereas a dynamic address is issued automatically from a pool, usually by DHCP, for a limited lease; Static addresses suit devices that must always be found at the same address, such as servers, whereas dynamic addressing suits ordinary client devices;	2
2(b) A2.3.1	Award [4] max Award [1] per point up to [4] max.	4

Q	ANSWER	MARKS
	Each device inside the house is given its own private address by the router; When a device sends data to the internet, the router replaces the private source address with the household's single public address; The router records the translation in a table, together with a port number that identifies which device the traffic came from; When the reply arrives, the router looks up that entry and forwards the data to the correct internal device; Many devices therefore share one public address, which reduces the number of scarce IPv4 addresses needed;	
3(a) A2.3.2	Award [1] max Fibre optic cable;	1
3(b) A2.3.2	Award [4] max Award up to [2] per factor (point plus expansion), [4] max, for two different factors. The answer must be linked to the 800 metre link. Award FT from a wrong medium in (a) if justified consistently. Attenuation and range Signal loss in fibre is very low over long distances; ...(so) 800 metres can be covered without the signal boosters that twisted pair would need beyond about 100 metres; Bandwidth Fibre carries far more data per second than twisted pair or wireless; ...(so) it can support the combined traffic of two whole buildings; Interference Fibre carries light rather than electrical signals, so it is immune to electromagnetic interference; ...(so) the link stays reliable even when run near power cables or machinery; Security Fibre is very difficult to tap without the intrusion being detected; ...(so) traffic between the buildings is better protected than it would be over wireless; Credit a valid counter-factor (higher cost, harder installation) only if it forms part of a justification, not on its own.	4
3(c) A2.3.2	Award [2] max Award [1] for the point and [1] for the expansion. Any one disadvantage. Wireless signals weaken with distance and are blocked by walls and floors; ...(so) coverage is uneven and speeds drop away from the access point; The bandwidth of an access point is shared between everyone connected to it; ...(so) performance falls as more students connect; Wireless is susceptible to interference from other devices and networks; ...(so) the connection is less reliable than a dedicated cable; The signal travels through the air beyond the building; ...(so) it can be intercepted, making encryption essential;	2
4(a) A2.3.3	Award [2] max Award [1] per point up to [2] max. A packet contains a header and the payload, which is the section of the original data being carried;	2

Q	ANSWER	MARKS
	The header holds the source and destination IP addresses used to route the packet; The header also holds a sequence number so the packets can be put back in order; It may include error-checking information such as a checksum, and a time to live;	
4(b) A2.3.3	Award [4] max Award [1] per point up to [4] max. The file is segmented into many small packets before it is sent; Each packet carries the destination address, so it can be routed independently of the others; Routers forward each packet along whichever path is best at that moment, so packets may take different routes and arrive out of order; Each packet also carries a sequence number, so the receiving server knows the order they belong in; The server reassembles the payloads in sequence order to rebuild the original file; Error checking detects damaged or missing packets, and those packets are requested again;	4
5 A2.3.3 A2.1.3	Award [4] max Award up to [1] per comparison point, [4] max. Both devices must be referred to. Award a maximum of [2] if only one device is described. A switch forwards data between devices on the same network, whereas a router forwards packets between different networks; A switch uses the MAC address to decide which port to send a frame to, whereas a router uses the destination IP address; A switch sends the frame only to the port of the intended device, reducing unnecessary traffic within the network; A router examines its routing table to choose the next hop towards the destination, so it decides the path a packet takes across the internet; A router provides the connection between the local network and the outside world, which a switch does not;	4
HL 6(a) A2.3.4	Award [2] max Award [1] per point up to [2] max. The network administrator enters each route into the routing table manually; Those routes stay fixed until somebody changes them, and are not updated automatically; Routers do not exchange routing information with one another;	2
HL 6(b) A2.3.4	Award [3] max Award [1] per point up to [3] max. The answer must be linked to the company's growth. With eleven offices the number of routes to configure by hand becomes large and error-prone; Dynamic routing lets the routers exchange information and build their tables automatically, so no manual entry is needed as offices are added; Scalability is better: adding a new office does not require every other router to be reconfigured; If a link fails, dynamic routing converges on an alternative path automatically, whereas static routes would keep sending traffic down the broken link until an administrator intervened; The trade-off is that dynamic routing uses more processing, memory and bandwidth, which mattered less once the network outgrew a single office;	3

Total for this paper: 34 marks