QUESTION 3.

3 **(a)** Any point 1 mark

sender's IP address
receiver's IP address
packet sequence number
checksum

[Max 2]

(b) Any point 1 mark

email has been split up into packets
packet has destination address
packets pass through many different routers in journey
packets don't take same route
routers use IP addresses
packets reassembled at destination to rebuild email

[Max 3]

(c) Any point 1 mark

email message is only read when all of it is received
time delays due to lost / delayed packets not significant
so sending different packets by different routes is not issue / is efficient
packets arriving out of order not an issue
no requirement for a continuous circuit (circuit switching)

[Max 2]

(d) Circuit switching [1]

(e) e.g. real-time video / video conferencing [1]

Any point 1 mark

circuit made available is dedicated to this communication stream
full bandwidth available / no sharing
no lost packets
guaranteed quality of service [Max 2]

QUESTION 4.

3 **(a)** dedicated circuit/channel/physical path [1]
which lasts for duration of connection [1]

(b) e.g.
cs: gives dedicated circuit [1]
ps: split into packets/chunks [1]
ps: sends packets on individual routes [1]
cs: whole bandwidth available // ps: shares bandwidth [1]
cs: faster data transfer [1]
cs: packets arrive in order they are sent [1]
cs: packets cannot get lost [1]
cs: better for a real-time application [1]
ps: packets may arrive out of order so delay until packet order restored [1]
ps: packets may get lost so retransmission causes delays [1]
[max. 6]

(c) web page divided into packets/chunks [1]
each packet has destination address [1]
router looks at IP address… [1]
and decides where to send packet next for most efficient path [1]
packets can take different routes [1]
home computer reassembles packets to rebuild web page [1]
[max. 3]

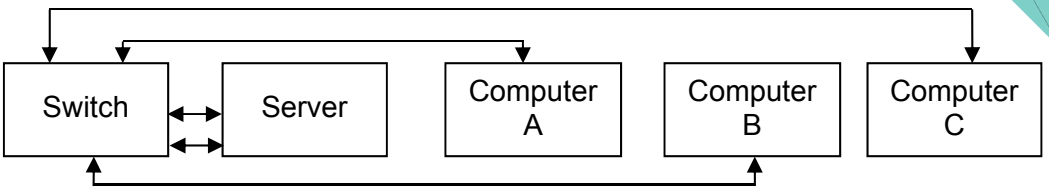
QUESTION 5.

Question	Answer	
5(a)(i)	Packet: Both web page and web page request are split into packets 1 Each packet is sent individually from device to device 1	
5(a)(ii)	Router: Transmit packets Contain connections to many other routers When packets arrive at router, router decides where next to send packet 1 mark for any valid point	**Max 2**
5(a)(iii)	TCP/IP: Is the protocol 1 Rules for communication between web server and browser 1	**2**
5(b)(i)	**Two** from: Picture and sound not synchronised 1 Interruptions // video not continuous 1 Can be degraded by other competing traffic 1	**Max 2**
5(b)(ii)	Dedicated communications channel between the two communicating devices 1 Established prior to start of communication // removal of links at end of communication 1	**2**
5(b)(iii)	In packet switching, packets can take different routes and may not arrive in order Will arrive in order (only one route) As packets can take many different routes / share paths with others can be delayed Dedicated circuit has full bandwidth No loss of synch 1 mark for any valid point	**Max 3**

QUESTION 6.

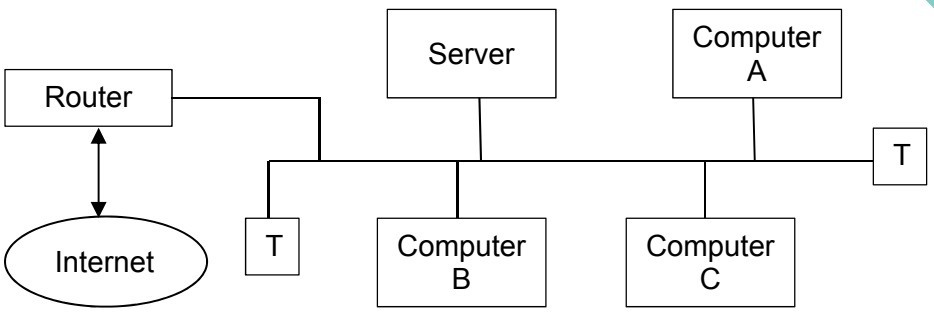
Question	Answer	
5(a)(i)	Packet: Both web page and web page request are split into packets 1 Each packet is sent individually from device to device 1	
5(a)(ii)	Router: Transmit packets Contain connections to many other routers When packets arrive at router, router decides where next to send packet 1 mark for any valid point	**Max 2**
5(a)(iii)	TCP/IP: Is the protocol 1 Rules for communication between web server and browser 1	**2**
5(b)(i)	**Two** from: Picture and sound not synchronised 1 Interruptions // video not continuous 1 Can be degraded by other competing traffic 1	**Max 2**
5(b)(ii)	Dedicated communications channel between the two communicating devices 1 Established prior to start of communication // removal of links at end of communication 1	**2**
5(b)(iii)	In packet switching, packets can take different routes and may not arrive in order Will arrive in order (only one route) As packets can take many different routes / share paths with others can be delayed Dedicated circuit has full bandwidth No loss of synch 1 mark for any valid point	**Max 3**

QUESTION 7.

<table>
<tr><th>Question</th><th>Answer</th><th></th></tr>
<tr><td>1(a)</td><td> 

Three lines with arrows – one from each device to switch</td><td></td></tr>
<tr><td>1(b)</td><td>
<table>
<tr><th>Statement</th><th>True</th><th>False</th><th></th></tr>
<tr><td>The server can send packets to Computer B and Computer C at the same time.</td><td>✓</td><td></td><td>1</td></tr>
<tr><td>The network software on each computer needs to include collision detection and avoidance.</td><td></td><td>✓</td><td>1</td></tr>
<tr><td>Computer B can read the packet sent from the server to Computer C.</td><td></td><td>✓</td><td>1</td></tr>
<tr><td>Computer A can send a packet to Computer B and at the same time the server can be sending a packet to Computer C.</td><td>✓</td><td></td><td>1</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>1(c)(i)</td><td>Device: Server 1
The server can provide a (software) firewall // The server can check all internet traffic // Server acts as proxy 1
Device: Switch 1
Internet traffic by passes the server // Server not overloaded with internet traffic // connected to all computers 1
1 mark for device, 1 mark for suitable reason</td><td>2</td></tr>
<tr><td>1(c)(ii)</td><td>• Router acts as gateway
• Router acts as a firewall
• The LAN and the Internet are two different networks
• (may) operate on different protocols
• Router forwards packets between networks
• Router has a public IP address
• Router holds a list of local addresses
• Router translates local addresses to Internet (IP) addresses (and vice versa)
1 mark for each point, max 2</td><td>2</td></tr>
<tr><td>1(c)(iii)</td><td>• Each packet has the IP address of the web server / destination address
• The routers use routing tables
• Routers on the Internet forward packets towards destination
• Packets can take different routes from source to destination
• Packets are reassembled in order at the web server
1 mark for each point, max 3</td><td>3</td></tr>
</table>

QUESTION 8.

Question	Answer	
1(a)	 Each device has a single connection to the bus (1) One terminator at each end (1) The terminators do not need to be labelled as long as they are obvious	
1(b)	<table><tr><th>Statement</th><th>True</th><th>False</th></tr><tr><td>The server can send packets to Computer B and the router at the same time.</td><td></td><td>✓</td></tr><tr><td>Computer C uses the IP address of a web server to send a request for a web page on the web server</td><td>✓</td><td></td></tr><tr><td>Computer B can read a packet sent from Computer A to Computer C.</td><td>✓</td><td></td></tr><tr><td>The server can read all incoming packets from the Internet.</td><td>✓</td><td>✓</td></tr></table> (1) (1) (1) (1)	**4**
1(c)(i)	• Only one transmission is allowed on the bus at <u>any one time</u> // only one packet can be transmitted on the bus at <u>any one time</u> (1) • The two packets from A and B cannot both use the bus at the same time (1) • The attempts to transmit will be unsuccessful, because the stations will realise that the bus is busy (1) • Reference to CSMA/CD (1) • Collision causes a change in voltage of the bus (1) **1 mark** for each point, **max 2**	**2**
1(c)(ii)	**One mark** for valid point, **max 2** • Calculate a <u>random</u> wait time • Wait for the <u>random</u> time • Check for idle bus // Check status of bus • Attempt to re-transmit / re-send • If unable to transmit, repeat process	**2**

Question	Answer	
1(d)(i)	• Star topology (1) • Where each computer / device has its own dedicated connection to the server (1) Alternative answers: Mesh topology (1) Every device connects directly to every other device (1) Ring topology (1) Use of tokens means no collisions // Every device examines every packet (1)	
1(d)(ii)	As each computer is now not sharing a single bus // has dedicated path (to the server) (1) Collisions cannot occur (1) Alternative answers: Mesh As each device now has a direct path to all the others (1) Collisions cannot occur (1) Ring Packets all travel in the same direction (1) Collisions cannot occur (1)	**2**

QUESTION 9.

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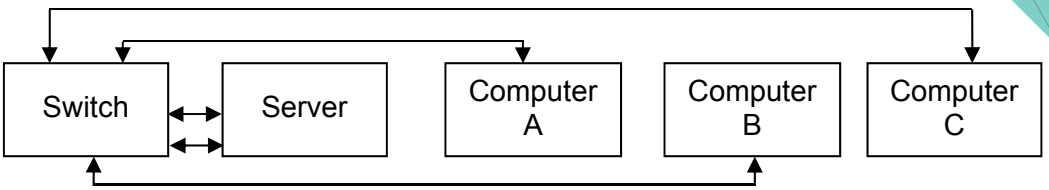
<tr><td>1(a)</td><td> 

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• Routers on the Internet forward packets towards destination
• Packets can take different routes from source to destination
• Packets are reassembled in order at the web server
1 mark for each point, max 3</td><td>3</td></tr>
</table>

QUESTION 10.

Question	Answer	Marks
1(a)(i)	1 mark per bullet point: • Correct value for exponent identified e.g. (0.010101 × 2^)5 • Used to give correct value e.g. 1010.1 or 21/64 x 32 • Correct answer i.e. 10.5 // 10½	**3**
1(a)(ii)	1 mark per bullet point: • Correct binary value i.e. 111.1 • Value for exponent identified e.g. (0.1111 × 2^)3 • Correct answer i.e. 01111000 00000011	**3**
1(a)(iii)	1 mark per bullet point: • Any working method for conversion • Applied accurately • Correct answer i.e. 10001000 00000011	**3**
1(b)(i)	Largest (positive) number (in this format)	**1**
1(b)(ii)	Overflow // too large to represent // would become negative	**1**

Question	Answer	Marks
2(a)	1 mark per bullet point to max 3: • Must have a central device • Each node is connected to the central device • Each node has a dedicated connection • Each connection must be bidirectional • Nodes may operate under different protocols	**3**
2(b)(i)	1 mark per bullet point to max 2: • dedicated circuit/channel/(physical) path • connection established before/at the start of the communication • which lasts for duration of connection // circuit released at end of the communication • all data is transmitted along the same route	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(b)(ii)</td><td>1 mark for each row:
<table>
<tr><th>Statements</th><th>Circuit switching</th><th>Packet switching</th></tr>
<tr><td>Shares bandwidth</td><td></td><td>✓</td></tr>
<tr><td>Data may arrive out of order</td><td></td><td>✓</td></tr>
<tr><td>Data can be corrupted</td><td>✓</td><td>✓</td></tr>
<tr><td>Data are less likely to get lost</td><td>either✓</td><td>or✓</td></tr>
</table></td><td>4</td></tr>
</table>

QUESTION 11.

Question	Answer	
2(a)	Circuit switching	
2(b)	**1 mark** Any real-time application e.g. video conferencing // live streaming of a concert Justification **1 mark** per bullet to max 2 • reduced latency • there are little/no delays in sending/receiving data once the circuit is set up • because (stringent) error checking (as used in packet switching) is not required • circuit made available is dedicated to this communication stream	

Question	Answer	Marks

QUESTION 12.

Question	Answer	Marks
7(a)	**1 mark** per bullet point • Application • Transport • Internet / Network • Data Link	**4**
7(b)(i)	**1 mark** per bullet point to **max 2** • Packet switching makes best use of the available (channel) capacity • … by using alternative routes • … which is more secure / robust • … as packets to / from different sources and destinations can share the same route	**2**
7(b)(ii)	**1 mark** per bullet point to **max 2** • To store data about packet • … and its routing // to ensure it reaches its destination • ... to ensure that message can be properly reconstructed	**2**

Question	Answer
7(b)(ii)	**1 mark** per item to **max 3** For example: • IP address of sender • IP address of destination • IP version • Number of packets the message consists of • ID number of that packet • Protocol used • Packet length • Time to live // max number of hops • Synchronisation data • Source port • Destination Port • Checksum