Answer

Answer 1

3(a)(i)	Any **three** from: • A circuit is established at the start of the communication • Between sender and receiver • This lasts for the duration of the call/data transfer • Then the links that make up the circuit are removed	**3**
3(a)(ii)	Any **two** from: • A dedicated channel // Not sharing channel • …can use all bandwidth • Two-way real time conversation • No delay as no switching • Data arrives in order it is sent	**2**

3(b)(i)	Any **three** from: • A circuit does not have to be established at the start of the communication • The data to be sent is divided into packets • That can travel along different routes • From node to node • Packets are reassembled in the correct order at the receiver's end • Must wait until the last packet is received to put the data back together	**3**
3(b)(ii)	Any **two** from: • Communication is asynchronous • Allows for error checking • Real time transmission is not required • Smaller amounts of data are sent (than voice calls) therefore dedicated line/higher bandwidth not required // can share the bandwidth • Doesn't matter if data arrives out of order	**2**

Answer 2

3(a)(i)	Any **five** from A layered model / stack … with 4 layers Uses a set of protocols for transmission of data .. transport control protocol with internet protocol Named layers of Application Layer, Transport Layer, Internet/Network Layer, Data Link Layer two layers correct … … all four layers correct … in the correct order	**5**

3(a)(ii)	**One** mark for protocol, **four** marks for description Protocol: BitTorrent Description: Any **four** from BitTorrent client software made available to friends and family's computers a complete copy of the torrent/file to be shared is available on at least one computer the torrent/file is split into small pieces… … rare pieces are given priority for downloading the torrent descriptor file is made available a computer/user joins (the swarm) by using the BitTorrent software to load the torrent descriptor file the computer/user can now download a piece of the torrent/file once a computer has a piece/ the whole file, it can become a seed (and upload to other members of the swarm) pieces of the torrent/file are both downloaded and uploaded (by each member of the of the swarm) a server called a tracker keeps records of all the computers in the swarm the tracker shares their IP addresses allowing connection to each other	**5**

3(b)(i)	**One** mark for method Method: Packet switching **Three** marks for description, any **three** from Description: file is divided into packets … and necessary data added to each packet, e.g. header which are sent independently of each other and do not need to take the same route packets are reassembled at the destination missing / corrupt packets can be resent	**4**

3(b)(ii)	**One** mark for benefit, **one** mark for drawback
	
	Benefit:
	packets can be rerouted if there are problems
	// packets can take the least congested route
	// transmission errors can be detected
	// missing / corrupt packets can be resent
	
	Drawback: packets can be dropped / delayed
		2

Answer 3

3(a)	Set of rules For (successful) transmission (and receipt) of data	**2**
3(b)	**One** mark for protocol, **one** mark for purpose must match protocol Any **two pairs** from Protocol: POP3 Purpose: downloading email Protocol: SMTP Purpose: sending/transferring email Protocol: IMAP Purpose: downloading email // storing/organising emails on an email server Protocol: HTTP/HTTPS Purpose: accessing email using a browser	**4**

3(c)(i)	**One** mark for method, max **two** marks for description Method: Circuit switching Description: Set up for the duration of the conversation Set up before communication starts Maintained throughout the transmission All data travels down the same route Dropped at the end of the transmission Complete bandwidth used	**3**
3(c)(ii)	**One** mark for benefit, **one** mark for limitation Benefit: Manav and Miora can see other in real time // better synchronisation // full bandwidth available Drawback: Bandwidth / channel not available to other users // extra time required to set up circuit at start of conversation // alternative route not available without restarting the conversation // less secure as easier to intercept data if only one channel used // failure single route used means failure of transmission	**2**

Answer 4

2(a)	Circuit switching	**1**
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	**3**

Answer 5

3(a)	**1 mark** per bullet point to **max 2** • Provide a set of standards for transmission of data • … that gives a known/accepted set of rules for transmitting and receiving data • This enables communication/compatibility between devices from different manufacturers/platforms etc.	**2**

Answer 6

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**
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	**3**

Answer 7

3(b)	1 mark for each correct pair of letters in the right order max **3** 1 Computer X sends a connection request to Computer Y. 2 Computer Y sends ready or busy signal. 3 If busy, Computer X waits and then resends the connection request to Computer Y. 4 **D** 5 **A** 6 **C** 7 **B**	**3**

<table>
<tr><td>3(c)(i)</td><td>1 mark for each layer
<table><tr><th>Protocol</th><th>Layer</th></tr><tr><td>TCP</td><td>Transport</td></tr><tr><td>IP</td><td>Internet/Network</td></tr><tr><td>SMTP</td><td>Application</td></tr></table></td><td>3</td></tr>
<tr><td>3(c)(ii)</td><td>Any three points from:
∞ BitTorrent client software made available
∞ One computer must keep a complete copy of the torrent/file to be shared
∞ Torrent/file is split into small pieces
∞ A computer joins (a swarm) by using the BitTorrent software to load a torrent descriptor file
∞ The computer can now download a piece of the file
∞ Once a computer has a piece it can become a seed and upload (to other members of the swarm)
∞ Pieces of the torrent are both downloaded and uploaded (by each member of the of the swarm)
∞ A server called a tracker keeps records of all the computers in the swarm
∞ The tracker shares their IP addresses allowing them to connect to each other</td><td>3</td></tr>
</table>

Answer 8

<table>
<tr><td>4(a)</td><td>1 mark per correct row
<table><tr><th>Responsibility</th><th>TCP</th><th>IP</th></tr><tr><td>Correct routing</td><td></td><td>✓</td></tr><tr><td>Host to host communication</td><td>✓</td><td></td></tr><tr><td>Communication between networks</td><td></td><td>✓</td></tr><tr><td>Retransmitting missing packets</td><td>✓</td><td></td></tr><tr><td>Reassembling packets into the correct order</td><td>✓</td><td></td></tr></table></td><td>5</td></tr>
<tr><td>4(b)</td><td>1 mark for name, 1 mark for matching use, max 4 for 2 protocols
• POP3/IMAP (1) receiving emails // download emails from a server (1)
• SMTP (1) sending emails (1)
• FTP (1) allows files to be transferred from one computer to another (1)
• HTTP/HTTPS (1) transfer of web pages/hypertext (1)
• Bit Torrent (1) used for peer-to-peer file sharing (1)</td><td>4</td></tr>
<tr><td>4(c)</td><td>Internet / Network (layer)</td><td>1</td></tr>
</table>

4(d)(i)	**1** mark per bullet to max **4** • Message data / payload • IP version number • Internet header length • Type of service • Explicit Congestion Notification • Total length/size of packet (in bytes) • Identification / sequence / packet number • Fragmentation flags • Fragmentation offset • Time to live // number of hops • Protocol • (Header) checksum • Source (IP) address • Destination (IP) address	**4**
4(d)(ii)	**1** mark per benefit, **1** mark per expansion, max **4** for 2 benefits For example : • alternative route available… • in case of network problem • If packet fails to arrive… • then only that packet has to be resent	**4**
4(d)(iii)	**1** mark per bullet to max **2** • Network ID // (IP Address of) network destination (1) Subnetmask (1) • Routing metric // data to decide best route • (IP Addresses of possible) next hop / Gateway • Interface	**2**

Answer 9

3(b)(i)	1 mark per bullet point to max 3: ∞ allows applications to exchange data ∞ establishes and maintains a connection … ∞ … until exchange of data is complete ∞ determines how to break application data into packets ∞ adds sequence / packet number to (TCP) header ∞ sends packets to and accepts packets from the network / Internet layer ∞ manages flow control // manages congestion avoidance ∞ acknowledges all packets that arrive ∞ detects when a packet has not arrived at destination ∞ handles retransmission of dropped packets ∞ reassembles packets into the correct order	**3**
3(b)(ii)	1 mark per bullet point to max 2 ∞ routes the packets around the network ∞ adds to the IP header a source/destination address for each packet ∞ encapsulates data into datagram ∞ passes datagram to the network access layer (for transmission on the LAN)// passes datagram to the transport layer (on arrival at destination) ∞ Defines the addressing method e.g. subnetting, NAT	**2**

3(b)(iii)	HTTP(S) // FTP // POP3 // SMTP // UDP // etc...	**1**
3(c)	1 mark for appropriate protocol in each layer **Layer** / **Protocol** Application: HTTP(S) // FTP // POP3 // SMTP // UDP etc... Transport: TCP Internet: IP	**3**
3(d)	1 mark per bullet point to max 4: ∞ Message is split into packets ∞ Each packet is a fixed size ∞ Each packet is given a header…. ∞ …including destination IP address, sequence number etc. ∞ Packets are forwarded from one LAN to the other LAN ∞ Packets may take different routes ∞ Missing packets are requested to be resent ∞ Packets re-assembled into order at destination	**4**

Answer 10

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(b)(ii)	1 mark for each row: **Statements** / **Circuit switching** / **Packet switching** Shares bandwidth: ✓ Data may arrive out of order: ✓ Data can be corrupted: ✓ / ✓ Data are less likely to get lost: either✓ / or✓

Answer 11

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	**2**
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**

Answer 12

5(a)	Option 1 / Option 2 Application Layer / Application Layer **Transport** / **Transport (Layer)** 1 **Internet** / **Network (Layer)** 1 **Network Interface** / **(Data) Link (Layer)** 1	**3**
5(b)(i)	Peer-to-peer	**1**
5(b)(ii)	File sharing	**1**
5(b)(iii)	Any four points from the following: • Torrent descriptor file is made available • File to be shared is split into pieces • BitTorrent client software made available to other peers / users / computers Allowing them to work as seeds or leeches. A peer can act as a 'seed' – used to upload pieces of a file Peer downloading file can get pieces from different seeds simultaneously • Once a peer has a piece of the file it can become a seed for the parts downloaded Leeches download much more than they upload • Central server called a tracker keeps records of all the peers ('swarm') and the parts of the file they have Can pause and restart at any time.	**Max 4**
5(c)	Any two protocols from: HTTP/HTTPS … 1 Used for transfer of web pages from server to client 1 FTP … 1 Used for interactive file transfer 1 SMTP … 1 Used for sending email messages 1 POP3 … 1 Used for incoming email messages 1	**Max 4**

Answer 13

5 (a) (i)

Application
Transport
Internet
Network / Link

[1]

[1]

[1]

(ii) software / module / program / code [1]

(b) (i) For example:
check packet port … [1]
to identify the application type [1]
check packet destination socket … [1]
so that packet sent to correct application [1]
check incoming packet sequence number … [1]
to ensure data is reassembled in correct order [1]
recalculate checksum of packet … [1]
to ensure integrity of packet [1]
if packet checksum invalid … [1]
send message to have packet retransmitted [1]

[Max 2 tasks]

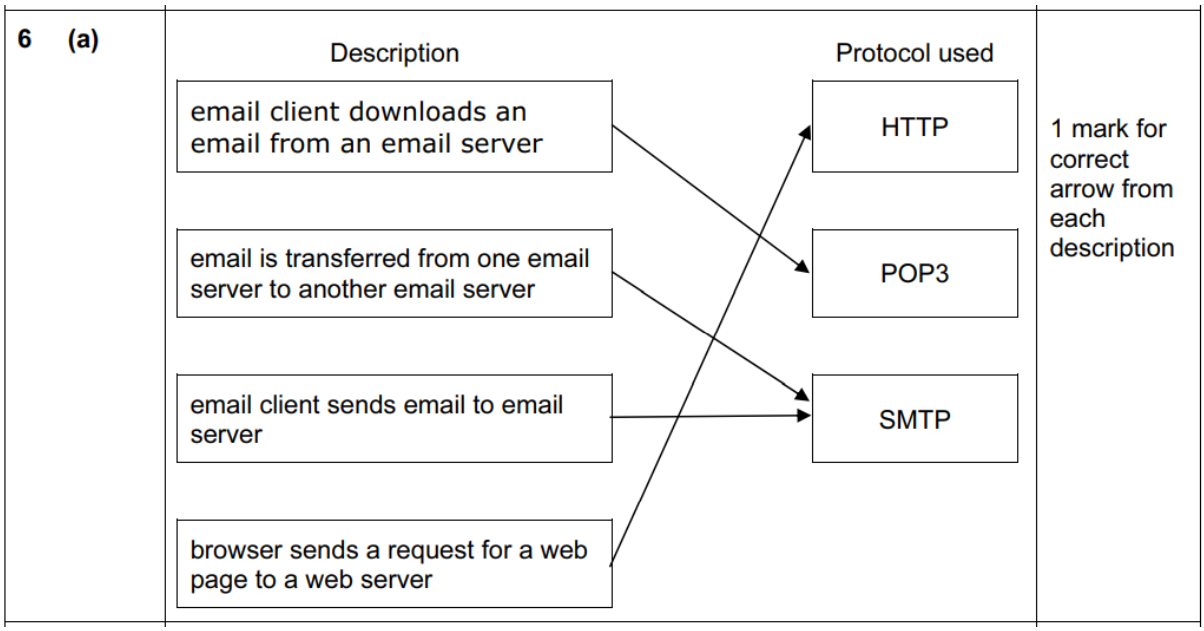
[Max 4]

(ii) HTTP / HTTPS [1]

(iii) POP3 [1]

Answer 14

6 (a)



1 mark for correct arrow from each description

(b)	peer-to-peer	1

(c) (i)	**Tracke**r: central server that:
	stores details of other computers that have all / part of file to be downloaded
	// has data on those peers downloading and uploading file
	// shares IP addresses with other clients in swarm allowing them to connect
		1
		
		1

(ii)	**Seed**: peer computer that has 100% of file // is uploading downloaded content	1 1
(iii)	**Swarm**: all the connected peer computers that have all or part of the file to be downloaded / uploaded // share a torrent	1 1
		Total: 11

Answer 15

(b) (i)	**Server**: central computer stores files that are to be downloaded	1 1

(ii)	**Command**: user can send action/instruction (or by example, e.g. change directory) that are carried out on server	1 1
(iii)	**Anonymous**: allows user to access files user does not need to identify themselves to server	1 1

Answer 16

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]

Answer 17

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]