Chapter # 13 – Networks

Specimen 2017

1 A television station makes its programmes in studios on the ground and transmits them via satellites to receivers in viewers' homes.

(a) Describe how a programme is transmitted from the station's studio to a viewer's satellite receiver.

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Answer:

1(a)	Award 1 mark for each correct answer up to a maximum of 4. **Four** from: The television (TV) programme from the studio is converted to digital data/ modulated onto a carrier wave The TV signal is sent from the studio to a ground/uplink dish station by high capacity circuit/microwave/fibre optic cable The signal is uplinked to a geostationary satellite from the ground/uplink dish station The frequency/channel of the signal is changed ready for downlinking The viewer's dish is in line of sight of the satellite The signal is sent from the satellite transponder to viewer's dish The LNB on the viewer's dish collects signals from the satellite A cable downlinks the signal to the receiver box A satellite decoder/set top box processes signals for use by the TV	**4**

Question 1, Part (b)

(b) Explain **two** advantages to the viewer of using satellites to receive television programmes.

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Answer:

1(b)	Award 1 mark for each correct answer up to a maximum of 2. **Two** from: Satellite TV can be transmitted with higher data rates so the viewer can watch high-quality audio and video Satellite TV can be received in most areas so when a terrestrial signal/cable TV is not available TV can still be watched The viewer has access to hundreds of channels so can view programmes from around the world/many TV stations The viewer has a greater choice of programmes so can select the ones that are wanted/interesting and discard the channels not wanted	**2**

Question 1, Part (c)

(c) Explain **two** disadvantages to the viewer of using satellites to receive television programmes.

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Answer:

1(c)	Award 1 mark for each correct answer up to a maximum of 2. **Two** from: The initial cost to the viewer is higher because the receiver and satellite dish can be expensive to purchase/install Viewers will need a separate receiver for each TV set so it can be expensive if more than one TV set is in use Poor/bad weather can cause the loss of satellite signals/reception so no programmes can be watched in very bad weather Viewers may have to pay extra/subscriptions to watch some programmes	**2**

4 A bank has a number of offices all over the world. Each office has a local area network (LAN). The LANs are connected together to create a wide area network (WAN) for use by its staff.

One of the office managers wants to improve the speed and efficiency of his office LAN. He wants to replace the existing copper cabling with an alternative communication method.

(a) Evaluate **three** alternative methods of transmission the manager could use including optical methods.

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Question 4, Part (a)

Answer:

4(a)	Award 1 mark for each correct answer up to a maximum of 8. **Eight** from: *Infrared transmission* Is only effective over short distances so other technologies would be more effective Can be blocked by walls/obstacles unlike radio waves ... which further limits the range of effectiveness ... ... but does reduce the risk of eavesdroppers outside the network Can carry a higher bandwidth compared to radio transmission Relies on line of sight unlike radio transmission *Fibre optic cable* In the long term a one-off installation cost is cheaper than copper cabling Many times more bandwidth per cable than a copper cable Much larger transmission distance than copper cable which is limited to 100 metres and needs switches to relay signals over this distance Optical cable transmits data up to 100 km resulting in the need for far fewer network cabinets which means lower cooling costs Optical cable is immune to external radio frequency or electromagnetic interference, unlike copper which can pick up interference from a number of sources along its run that may degrade the speed considerably Optical cable does not need lightning protection In the event of a lightning strike or surge will not damage equipment connected to it Fibre optic cabling is much lighter than copper, making it easier to transport and install Initial cost is highly expensive compared to other methods Optical cable in a LAN requires special expensive network cards Fitting optical cable requires special training If an optical cable breaks, local IT technicians may not be able to repair it themselves	**8**

Question 4, Part (a)

Answer (Continued):

	Point-to-point laser transmission Faster data transmission/bit rate Greater bandwidth Needs receivers/outlets to relay to stations – cannot transmit directly Relies on line of sight unlike radio wave transmission Error rates in data transmission are lower than with radio waves Can be used for quantum key distribution when using quantum key cryptography unlike radio wave transmission *Radio wave transmission* Can access network resources from any location within the wireless network's coverage area or from any WiFi hotspot Office-based workers are not limited to working at their desks as with a cabled connection Wireless networks are more easily expanded with existing equipment, while a cabled network might require additional wiring Wireless networks eliminate or reduce wiring costs Radio transmission does not rely on line of sight unlike some other methods	
4(a)	*Bluetooth* USB 3.0 interferes with Bluetooth signal Slowest bit rate of all transmission systems Obstacles do not affect data transmission/can transmit data through walls unlike infrared transmission Range is greater than infrared transmission but lower than cabled or laser beam The required processing power of devices is very low More limited in the number of devices which can be used	

Question 4, Part (b)

(b) Describe the role of **three** types of server that might be found in an office LAN.

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Question 4, Part (b)

Answer:

4(b)	Award a maximum of 2 marks per type of server up to a maximum of **three** server types. **Six** from e.g.: A **file server** is a computer responsible for the central storage and management of data files ... ... so that other computers on the same network can access the files A file server allows users to share information over a network without having to physically transfer files by Pen drive/CD-ROM A file server may be an ordinary PC that handles requests for files and sends them over the network A file server can be a dedicated network-attached storage (NAS) device that also serves as a remote hard disk drive for other computers ... ... allowing anyone on the network to store files on it as if storing files to their own hard drive An **application server** is a computer responsible for the central storage and management of applications ... ... so that other computers on the same network can access the applications An application server is a program that handles all application operations between users and an organization's backend business applications/ databases An application server is used for web applications usually performed in the same running environment as their web server Many application servers also implement services like clustering, fail-over and load-balancing A **print server** is a software application, network device or computer that manages print requests in a network A print server makes printer queue status information available to end users and network administrators In a large company a single computer acting as a print server might manage hundreds of printers In a small office a print server can be a plug-in board/small network ... ... that frees up valuable disk space on the office's computers	**6**

Question 4, Part (b)

Answer (Continued):

4(b)	A **mail server** handles and delivers email over a network A mail server can receive emails from client computers and deliver them to other mail servers A mail server can also deliver emails to client computers There are two main types of mail server – outgoing mail servers and incoming mail servers Outgoing mail servers are known as SMTP (Simple Mail Transfer Protocol) servers Incoming mail servers are usually either POP3(Post Office Protocol v3) servers or IMAP (Internet Message Access Protocol) servers A **database server** is a computer in a network used to store databases and retrieve information from them A database server holds the Database Management System (DBMS) and the databases It receives requests from the network computers and it searches the database for the selected records ... ... and passes these records back over the network A database server usually operates in a client-server network where it provides information sought by the client computers A **proxy server** is a server that acts as a buffer, receiving requests from clients seeking resources from other servers ... ... such as a file, connection, web page, or other resource available from a different server Usually proxy servers facilitate access to content on the World Wide Web A proxy server can be used to store/cache frequently visited web sites ... ... when the next user on the network visits the same site the page loads from the proxy server rather than having to search over the internet again ... ... significantly improving access speed for users on the network A proxy server can be used to control/prevent access to particular websites A **backup server** enables the backup of data, files, applications and/or databases on a network A backup server provides backup storage and retrieval services to connected computers, servers or other network devices A backup server is a server with very large storage capacity At the scheduled time, the host server connects with the backup server to initiate the data backup process	

Question 4, Part (b)

Answer (Continued):

	A **web server** stores, processes and delivers web pages to network users The communication between client and web server takes place using the Hypertext Transfer Protocol (HTTP) Web servers most frequently deliver HTML documents which may include images, style sheets and scripts in addition to text content A web browser makes a request for a specific resource using HTTP and the web server responds with the content of that resource or an error message if unable to do so	

Question 4, Part (c)

(c) Explain how the bank could use encryption techniques to attempt to prevent its data from being read by unauthorised people.

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Question 4, Part (c)

Answer:

4(c)	Award 1 mark for each correct answer up to a maximum of 6. **Six** from: Use of encryption key to scramble/make unreadable the data/files/folders Only users with encryption key can decrypt the data Encrypting folders/files containing the data to prevent unauthorised access Use of encrypted connections via network, e.g. SSL, VPNs Encryption occurs at the network transfer level (layers 3 and 4) of the OSI model ... using IPsec to create encrypted packets for transmission Data only encrypted during transmission on network	**6**

8 Shafiq has just logged on to a secure website.

(a) Describe how he knows that this website is secure.

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Answer:

8(a)	Award 1 mark for each correct answer up to a maximum of 2. **Two** from: A padlock is shown by the browser indicating that the data is encrypted during transmission The URL will show https indicating that a secure connection is being made Browser will display a warning if an invalid digital certificate is received from a website Browser will display a warning if a mixture of encrypted and unencrypted data is received from a website Browser address bar changes colour (to green) when using secure connections/extended digital certificates	**2**

Question 8, Part (b)

(b) Describe the steps that the web browser will go through to ensure that Shafiq has logged on to a secure website.

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Answer:

8(b)	Award 1 mark for each correct answer up to a maximum of 4. **Four** from: Browser initiates a connection to the secure website using https ... using the SSL protocol Browser uses https to authenticate the website ... by examining the server's digital certificate and comparing it with that held by certificating authorities Browser and web server establish a secure connection using public and private keys to generate a session key Transmitted/received data is encrypted using the session key Browser requests user ID and password from Shafiq Browser transmits user ID/password in encrypted form to website	**4**

9 **(a)** Describe what is meant by the use of biometrics when protecting devices from being accessed by unauthorised people.

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Answer:

9(a)	Award 1 mark for each correct answer up to a maximum of 2. **Two** from: Biometrics include data about facial recognition/iris recognition/retinal patterns/fingerprints/palm prints stored in computer chips Biometric data are read at point of access and compared to the stored data If the data match then access is allowed/if the data do not match access is not allowed	**2**

Question 9, Part (b)

(b) Many people are becoming concerned that too much reliance is being placed on the use of biometrics to protect devices from being accessed by unauthorised people.

Evaluate the suitability of biometrics for this purpose.

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Question 9, Part (b)

Answer:

9(b)	Award 1 mark for each correct answer up to a maximum of 8. Award a maximum of 6 marks if all points are in favour or all against. 1 mark can be awarded for a reasoned conclusion. *Points in favour of the use of biometrics, e.g.:* Biometric identifiers are unique to individuals ... so are more reliable in verifying the identity of an individual Use of biometrics must be difficult to circumvent/traits must be difficult to imitate or substitute ... to ensure an appropriate level of security Using biometrics removes the need for user IDs and passwords ... eliminating problems with forgotten or lost passwords ... eliminating the risk of fraudulent use of another's login details Biometric systems have fast matching speeds to deliver accurate results ... so delays in allowing access are minimised	**8**

Question 9, Part (b)

Answer (Continued):

	Points against the use of biometrics, e.g.: All people/everyone must have the trait being used for biometrics so the biometric data can be compared/measured on everyone Biometric data must be permanent/does not significantly change over time so algorithm will work over time Biometric data must be measurable/must be easy/quick to acquire the data from an individual so the individual is not inconvenienced/device is accessed quickly Biometric data must be in a form that allows processing/extraction of features for comparison Biometric data may be passed on to third parties/used for other purposes/ raises concerns regarding privacy and the inappropriate use of the data ... so individuals may not allow use of their data for this purpose/use of biometrics must be acceptable to participants There is a limit on the number of stored sets of data/maximum number of sets of data and this limits the usefulness of biometrics in large populations/with a large number of users Biometrics rely on the probability of inputs being valid so if the false acceptance rate is set incorrectly imposters can be shown as genuine Failure to detect a match between the input and the (matching) data stored can result in valid inputs being incorrectly rejected and access being improperly denied Failure to capture the biometric data when presented/failing to detect data when correctly presented results in the rejection of genuine readings and access is improperly denied	

June 2017 – P31 & P33

4 A wide area network uses a number of different protocols.

(a) Describe each of the following wide area network (WAN) protocols.

(i) HDLC:

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Answer:

4(a)(i)	***Two** from:* *(HDLC is):* High-Level Data Link Control Layer 2 (data link) protocol Connects point-to-point serial devices/leased lines Uses error correction Routers encapsulate HDLC before putting on LAN.	**2**

Question 4, Part (a)(ii)

(ii) Frame relay:

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Answer:

4(a)(ii)	***Two** from:* *(Frame relay is):* Layer 2 and 3/data link/network layer protocol Puts data into variable-sized packets/frames Does not include error-correction/error corrections is done by devices ...can be unreliable Specifies physical and logical link layers Used in packet switching Used on integrated services digital network (ISDN) Used in permanent virtual circuits (PVC) Can provide QoS ...worth constant bitrate/emulation of circuit switching.	**2**

Question 4, Part (b)

(b) An updated version of a free operating system has to be downloaded quickly. The operating system is contained in a very large file. There is a choice of using 'BitTorrent' or file transfer protocol (FTP) for the download.

Explain, with reasons, which method of download would be preferable.

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Answer:

4(b)	***Four** from:* If many people want the OS at once bit torrent is resistant to flash-dot/crowds/website overload/dos/FTP is not resistant to flash-dot/crowds/website overload/dos Bit torrents can be paused/stopped and restarted/FTP cannot restart if paused, so if interrupted the download has to be done again Bit torrent makes many small data requests from different IP connections/addresses/FTP is from one IP connection/address so is quicker to download the large OS file Bit torrent downloads file sections randomly/rarest first/ FTP is sequential download of file sections Bit torrent can be slow to get up to full speed/FTP achieves full speed as soon as it starts download and can achieve very high download speeds.	**4**

Question 4, Part (c)

(c) Describe how a network router provides connectivity between a home network and the internet.

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Answer:

4(c)	***Six** from:* Has two or more connections to different networks Router reads address information in the packet header ...to determine destination of packet ...has a routing table/policy ...contains data on all possible routes to groups of addresses ...priorities for connections for handling data packets ...routing tables are dynamic/can be updated ...directs packet to next router if destination address not known ...direct packets to address if destination is known Router updates 'hop' count every time it forwards a packet ...when 'hop' count limit is reached packet is dropped/discarded ...usually a maximum of 16 hops ...or marked as undeliverable ...so packet does not live forever on network/internet.	**6**

June 2017 – P32

2 Companies must protect the data that is used and stored on their networks.

(a) Evaluate the use of a firewall in protecting the data on a company network.

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Question 2, Part (a)

Answer:

2(a)	***Eight** from:* *Advantages:* A firewall can provide protection to multiple networked computers simultaneously Firewalls can monitor traffic coming in and going out of a network… …and produce log files for subsequent analysis Firewalls can enforce password controls to enter/use the network to try to prevent unauthorised users from gaining access Firewalls can enforce access policies so that only authorised users can access the network/parts of the network Firewalls reduce the risk of key logging software sending details to third parties by blocking the access out of the network *Disadvantages:* Firewalls are the central point of attack by hackers/potential intruders and once breached there are no further defences Firewalls can block legitimate process/applications so manual adjustment of settings may be required …can lead to allowing unwanted access by other processes if not configured by experts Firewalls are usually incapable of protecting against backdoor Trojans that open ports to send data to third parties who can then access the system Firewalls do not usually contain malware removal tools. *Max 6 for all advantages or all disadvantages.* *1 mark is available for a reasoned conclusion/opinion.*	**8**

Question 2, Part (b)

(b) Describe how a proxy server can help to protect a company network.

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Answer:

2(b)	***Four** from:* Acts as intermediary for client requests for services such as a web page/a file Provide content filtering to control the content that is accessed/enforce acceptable use policies Provide user authentication to control web access Provide detailed logs of user web activity/flag up unacceptable use by employees Provide links to anti-malware applications to check incoming/outgoing data Filtering based on URL lists …DNS blacklists …based on lists maintained by third party companies Can provide NAT/anonymity of IP address.	**4**

10 A country is considering launching a satellite to enhance its internet connectivity.

Evaluate the use of satellites for this purpose.

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Question 10

Answer:

10	**This question to be marked as Level of Response.** *Evaluation requires that advantages and disadvantages be discussed and weighed up in importance.* **Level 3 (7–8 marks)** Candidates will evaluate, in detail, by discussing the advantages and disadvantages of the use of satellites for data communications. The information will be relevant, clear, organised and presented in a structured and coherent format. There may be reasoned conclusions/opinions. Subject specific terminology will be used accurately and appropriately. **Level 2 (4–6 marks)** Candidates will evaluate by discussing the advantages and disadvantages of the use of satellites for data communications. For the most part, the information will be relevant and presented in a structured and coherent format. There may be reasoned conclusions/opinions. Subject specific terminology will be used appropriately and for the most part correctly. **Level 1 (1–3 marks)** Candidates will describe by giving the advantage(s) and/or disadvantage(s) the use of satellites for data communications. Answers may be in the form of a list. There will be little or no use of specialist terms. **Zero marks:** Response with no valid content.	**8**

Question 10

Answer (Continued):

	Answers may make reference to e.g.: *Advantages:* satellite communications: • easier to setup of mobile communications • are more economical than terrestrial communication over long distances • is most economical especially for low network traffic demands in remote areas • quality of transmitted signal is independent of distance • quality of transmitted signal does not depend on location of sending and receiving stations • country/owner has control over their own network *Disadvantages:* • huge initial cost of manufacture/launch • repair of satellite is almost impossible once it has been launched • can be affected by severe weather conditions/very dark clouds • can be affected by electromagnetic disturbances/events in space/sun activity • annoying time gap/delay between exchange of data reducing the efficiency of satellite communications for data transmission.	

November 2017 – P32

4 A new online supermarket will have a very large amount of data about its customers, products and services that has to be kept safe. Complete back-ups of all its data are to be created at regular intervals. Jaswinder, the IT manager, is considering the options of using tape-based systems, hard disk-based systems or back-ups to the 'cloud' for storing the back-ups.

Evaluate the three options for storing the back-ups.

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Question 4

Answer:

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This question to be marked as a Level of Response.

Evaluation requires that advantages and disadvantages be discussed and weighed up in importance.

Answers may make reference to e.g.:

Tape-based:
established technology
• huge storage capacity
• serial access
• cheap per GByte
• can be slow to create backup
• can be slow to recover files
• tapes can be fragile
• tapes may not work in different tape drives.

Hard disk-based:
• quick to produce backup
• quick to recover files
• direct access
• cost per GByte varies/can be expensive
• large capacities
• hard disk can fail losing large amounts of data.

'Cloud'-based:
• off-site technology used so not so vulnerable to on-site disasters
• hardware/maintenance/service costs borne by supplier
• security arranged by supplier
• security of data issues
• unlimited capacity available
• reliable internet connection required
• high bandwidth connection preferred.
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Level 3 (7–8 marks)

Candidates will evaluate in detail the options for creating backups.
The information will be relevant, clear, organised and presented in a structured and coherent format.
There will be a reasoned conclusion/opinion.
Subject specific terminology will be used accurately and appropriately.

Level 2 (4–6 marks)

Candidates will evaluate the options for creating backups.
For the most part, the information will be relevant and presented in a structured and coherent format.
There may be a reasoned conclusion/opinion.
Subject specific terminology will be used appropriately and for the most part correctly.

Level 1 (1–3 marks)

Candidates will describe the options for creating backups.
Answers may be in the form of a list.
There will be little or no use of specialist terms.

Level 0 (0 marks)

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6 Audio files can be digitised with different bit rates.

The bit rate of an audio file can appear to affect the quality of the sound when it is listened to.

Explain how you can affect the perceived quality of the sound stored in the audio file by changing the bit rate.

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Question 6

Answer:

6	***Six** from:* Audio quality improves with increasing bit rate ...two examples from: ...800 bit/s is minimum for speech to be recognised 32 kbit/s – generally acceptable only for speech 96 kbit/s – generally used for speech/low-quality streaming 128 or 160 kbit/s – mid-range bit rate quality 192 kbit/s – a commonly used high-quality bit rate 320 kbit/s – highest bit rate level supported by the MP3 standard ...lossy compression to reduce bit rate can introduce artefacts ...caused by data/quantisation errors ...distortion of sound ...perceived/heard as 'bubbling/burbling' ...stuttering/jerky/blanks/silences in sound.	**6**

8 A data protection act can contain principles that create rights for those people who have their data stored and processed by companies.

(a) Describe the rights that could be created by a data protection act.

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Answer:

8(a)	***Four** from:* *(Derived from section 7, sixth principle of Act:* *'personal data shall be processed in accordance with the rights of data subjects under this Act':)* A right of access to a copy of the information held in their personal data ...told whether personal data is being processed ...given a description of personal data ...given reason(s) for processing ...given details of source of data A right to object to processing that is likely to cause/is causing damage/distress A right to prevent processing for direct marketing A right to object to decisions being taken by automated means A right (in certain circumstances) to have inaccurate personal data rectified, blocked, erased or destroyed A right to claim compensation for damages caused by a breach of the Act.	**4**

Question 8, Part (b)

(b) Data controllers are appointed by companies to safeguard the rights of individuals whose data is stored.

Describe **two** criminal offences that may be committed by data controllers if they fail to abide by the principles of a data protection act.

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Answer:

8(b)	***Two** from:* Failure to register when required ...and to keep personal data if not registered ...failure to provide accurate information/providing false information when registering Failure to comply with provisions/stick to reasons for storing data supplied when registering Processing data if not registered To fail to provide Data Commissioner with updated address failure to comply with enforcement order ...prohibition notice e.g. not to send data overseas/supply data to third party ...information notice e.g. supplying false information/not all of information when ordered to do so.	**2**

9 WiFi is often used to connect devices to the internet. In some buildings, WiFi signals may be degraded so that data transfer appears to be 'slow'.

Explain how you could try to ensure that the WiFi system suffers minimal signal degradation.

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Question 9

Answer:

9	***Eight** from:* Other devices can cause interference ...remove other devices e.g. microwave ovens/cordless telephones on same frequency which can interfere with signal ...WiFi uses 2.4Ghz and/or 5GHz frequency Ensure that access points do not use same frequencies/channels... ...other access points may use same WiFi channel and interfere with user's channel Restrict use of e.g. Bluetooth® ...Bluetooth® signals can cause interference Restrict use of mobile phones... ...mobile telephone systems can cause interference Adjust wireless access point settings... ...wireless access point rate control set too high ...results in many retries Wireless devices can only send or receive but not both at the same time ...effectively cuts the bandwidth in half give devices with already established connections higher priority ...e.g. video streaming ...other devices appear to have slower access times/data transfer rates Radio waves are slowed/blocked/'bent' by objects ...walls/insulation/metal objects may degrade/block WiFi signals so use materials that are transparent to wireless signals Restrict choice of channels... ...automated channel choice can cause 'channel hopping' ...too many changes slows access times Restrict use of 'legacy' bands for WiFi ...routers are slower if they have to broadcast on several bands simultaneously Set access point antennas to optimum position/orientation ...may be set too low/wrong angle/hidden.	**8**

November 2017 – P33

7 A home network uses a router to connect to the internet.

(a) The router will act as a 'default gateway'.

Define 'default gateway'.

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Answer:

7(a)	***Two** from e.g.:* Default means that this gateway/address is used unless another address is specified Router/computer node that has details of where to forward data packets ....if no route known already Device that passes traffic from local subnet to devices on other subnet	**2**

Question 7, Part (b)

(b) The router uses wireless technology to allow devices in the home to connect to it.

Discuss the benefits and drawbacks of using wireless technology to connect devices to the router.

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Question 7, Part (b)

Answer:

7(b)	***Eight** from e.g.:* *Benefits:* Devices are easier to move around as no wires needed... ...no need to physically connect ...no trailing wires to trip over Greater productivity by home-workers as they can carry laptop/device with them while doing other tasks Ease of expansion with new devices as single access point required ...devices can be added without need to add cables/space for connection/additional hubs/switches ...no need to drill holes/damage house fittings/walls for cables Less expensive than wired connections so no cost of new hubs/switches/sockets/wires *Drawbacks:* Security issues so encryption required which may be difficult to set up Range issues as it is restricted to only 10s of metres from access point ....physical objects may interfere with signal ....reduced signal strength as distances from access point increases Reliability issues ...subject to interference from other wireless devices/electrical items Speed issues as rate of data transfer is lower than for cabled connections ...may vary during a session leading to poor user experience. *Max 6 for all benefits or all drawbacks.* *1 mark is available for a reasoned conclusion.*	**8**

March 2017 – P32

5 Global positioning systems (GPS) are used by navigation devices to allow drivers of cars to find locations and destinations.

(a) Describe how GPS signals from satellites are used by navigation devices to determine a location.

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Question 5, Part (a)

Answer:

5(a)	***Eight** from:* (Civilian) signals from satellite travel by line of sight to navigation device/ receiver Use L1/1575.42 MHz in UHF band Satellites are Low Earth Orbit/LEO Signal contains ID code of the satellite ...and status/health information ...and current date and time from atomic clock in the satellite ...and almanac data about where each GPS satellite is at any point in time Navigation device/ receiver must lock to (at least) 2 satellites to calculate 2D position (i.e. latitude and longitude) To 4 or more (usually 4 to 7) satellites to calculate 3D position (i.e. latitude, longitude and altitude/elevation) Using trilateration techniques Calculation by finding intersect point by timing the signals from the satellites	**8**

Question 5, Part (b)

Answer:

(b) Describe the factors that could degrade a GPS signal, when it is transmitted to a navigation device, and affect the accuracy of the location found by that device.

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Question 5, Part (b)

5(b)	***Five** from:* Atmospheric/ionosphere/ troposphere delays slowing the satellite signal slows as it passes through the atmosphere Signal multipath errors as the GPS signal is reflected off objects before it reaches the receiver ...increases the travel time of the signal Clock errors in the receiver because the built-in clock is not as accurate as the atomic clocks on board the GPS satellites Orbital errors (ephemeris errors) of the satellite's reported location The number of satellites visible may be too few because buildings/terrain/dense foliage may block the signal reception electronic interference can block the signals ...causing position errors /no position reading ...GPS units usually will not work indoors, underwater or underground Satellite geometry/shading because the relative position of the satellites at any given time is not ideal for signal reception by the receiver ...the satellites should be located at wide angles relative to each other ...poor geometry occurs when the satellites are located in a line/tight grouping Intentional degradation of the satellite signal by the operator/owner of the satellites ...to prevent military adversaries from using the highly accurate GPS signals	**5**

6 A customer in a restaurant can pay the bill with a credit card using a mobile chip and pin reader carried by a waiter.

Describe the computer processing involved in the payment of the bill by credit card using the mobile chip and pin reader.

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Question 6

Answer:

6	***Eight** from:* Reader communicates via secure wireless connection with restaurant base-station Base station communicates with bank computers Mobile reader reads the data from the card Requests input of PIN from customer PIN checked/validated against stored PIN Request sent to restaurant's bank to determine the cardholder's bank/issuing bank Request sent to card issuer/bank to authorise the transaction ...authorisation code sent to restaurant's bank if credit is available Credit card is validated/credit available ...if valid/available then transaction can proceed ...if not valid/available then transaction is refused If transaction can proceed the amount of the transaction is deducted from the cardholder's account Receipt is printed from the mobile reader	**8**

7 Electronic data exchange is often called electronic data interchange. An online retailer and its trading partners use electronic data interchange (EDI).

(a) Define EDI.

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Answer:

7(a)	***Three** from:* The computer-to-computer Exchange of business documents Using a standard electronic format Between business partners	**3**

Question 7, Part (b)

(b) The retailer has prepared an order that has to go to a supplier. When the supplier has received the order, an invoice asking for payment for the goods has to go back to the retailer.

Explain how you would use EDI for these transactions.

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Answer:

7(b)	***Five** from:* Prepare the documents to be sent Collect/organise the data via human interface screens/typing Extract from databases/spreadsheets/output from stock control/purchasing systems into data files Translate the documents into EDI format Convert internal data into EDI standard format Transmit the EDI documents to trading partner Use VPN/secure private network Via an EDI network provider that connects the trading partners together	**5**

8 Packet switching is used to transfer data around networks.

Discuss the benefits and drawbacks of packet switching.

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Question 8

Answer:

8	***Eight** from e.g.:* *Benefits of Packet Switching include e.g.:* Makes very efficient use of the network as communication lines are shared Data packets can be routed around unusable nodes/parts of the network so if part of network/node is faulty/not working packets can still reach destination The network only has to expand slowly with increase in users compared to circuit switching *Drawbacks of Packet Switching:* The packaging of the data changes each time a packet is switched so there is a time overhead/latency Can cause a problem for time-critical information such as an emergency signal/video streaming Small data packages are inefficiently packaged (e.g. a data package of 600 bytes uses two packets of 512 bytes plus the address information) *Max 6 for all benefits and drawbacks* *1 mark available for a reasoned conclusion/opinion*	**8**

June 2018 – P31

5 Discuss the benefits and drawbacks of the use of satellite technology in global positioning systems (GPS).

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Question 5

Answer:

5	This question to be marked as a Level of Response. **Level 3 (7–8 marks)** Candidates will discuss in detail, giving both benefits and drawbacks, of the use of the use of satellite technology in global positioning systems (GPS). The information will be relevant, clear, organised and presented in a structured and coherent format. There will be a reasoned conclusion/opinion. Subject specific terminology will be used accurately and appropriately. **Level 2 (4–6 marks)** Candidates will explain the use, giving a benefit and drawback, of the use of satellite technology in global positioning systems (GPS). For the most part, the information will be relevant and presented in a structured and coherent format. There may be a reasoned conclusion/opinion. Subject specific terminology will be used appropriately and for the most part correctly. **Level 1 (1–3 marks)** Candidates will describe, with a least one benefit/ drawback, of the use of the use of satellite technology in global positioning systems (GPS). Answers may be in the form of a list. There will be little or no use of specialist terms. **Level 0 (0 marks):** Response with no valid content.	**8**

Question 5

Answer (Continued):

	Answers may make reference to e.g.: *Benefits include:* Access to satellite signals is available over most of surface of earth unlike signals from terrestrial transmitters Transmission of GPS signals is not dependent on political boundaries Satellite signals are accessible over oceans where terrestrial transmissions are difficult to receive due to the long distances from land Signals are available to anyone who wishes to use them (unless switched off by operator of satellite) Satellites are vandal-proof/ inaccessible to those who would physically attempt to disrupt their function *Drawbacks include:* Requires a large number (c.25 to 35) of satellites to be in orbit to provide adequate coverage of terrain Cannot easily be repaired if malfunctioning Requires at least 3, preferably 4, satellites to be visible to / received by GPS receiver to achieve reliable/accurate positioning Satellite signals are blocked by solid objects/buildings/in tunnels/trees/dense clouds/ snow storms so, in these circumstances, GPS receivers may… …fail to provide locations …may provide erroneous locations.	

12 The networking of computers can give rise to a variety of issues.

Describe each of the following security issues and suggest how, other than using physical security methods, the risk from each may be reduced.

(a) DNS spoofing.

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Answer:

12(a)	**Five** *from:* *Max* ***three*** *(definition) from:* DNS spoofing is Domain Name System spoofing/Domain Name System cache poisoning Type of computer hacking Corrupt data is placed into cache of resolver of DNS/ISP DNS cache so that an incorrect IP address is returned Network traffic is diverted/redirected to a different computer to that which was requested/to hacker's computer *Max* ***three*** *(prevention) from:* DNS server configured to ignore request from other DNS servers that are not directly relevant to the query Use of secure DNS/public key encrypted/digitally signed data to ensure authenticity of DNS requests Performing end-to-end validation of DNS requests with HTTPS Defence is at transport layer.	**5**

Question 12, Part (b)

(b) DoS attack.

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Answer:

12(b)	**Five** *from:* *Max* ***three*** *(definition) from:* DoS is a Denial of Service attack Where a computer/system is made unavailable by overwhelming the target system with requests for service Requests for service are superfluous/have no purpose other than to disrupt/overload the system Can use many IP addresses/multiple computers/devices to carry out a DoS *Max* ***three*** *(prevention) from:* Use of firewall configured to deny incoming packets with IP addresses/ports from identified attackers Use of tools to analyse incoming data to identify 'spoof'/ unwanted/illegitimate requests Use of DNS blackhole/routing to re-route IP addresses intended for attacker to non-existent IP address/server Use of DNS sinkhole to direct traffic to valid IP address for analysis to reject unwanted packets Use of a specialised/commercial 'cleaning/scrubbing' servers/centre to separate out unwanted traffic from legitimate traffic Defence is at application layer.	**5**

Question 12, Part (c)

(c) ARP spoofing.

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Answer:

12(c)	**Four** *from:* *Max* ***three*** *(definition) from:* ARP spoofing is Address Resolution Protocol spoofing To associate/link MAC address of attacker's device to IP address of e.g. default gateway/another network host Occurs when IP address is resolved to a MAC address So that traffic is directed to attacker instead of intended host/device Data frames may be intercepted and modified/prevent traffic movement *Max* ***three*** *(prevention) from:* Use of DHCP server configurations to certify that IP addresses are correctly assigned Use of tools to cross-check ARP resolutions to block incorrect ones Built into switches/network devices Configuring the ARP cache in the OS to ignore requests for updates/hard coding the ARP cache in OS to prevent updates.	**4**

13 Companies use a range of physical security methods to try to prevent unauthorised access to the company data stored on their networks.

Evaluate the use of physical security methods in attempting to prevent unauthorised access to the stored data.

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Question 13

Answer:

13	**Eight** *from:* Locking the room when not in use …prevents unauthorised access to devices/computers …requires meticulous logging of who has key to room …requires strict adherence by users to rules e.g. no unlocking of doors for others to go in Using swipe cards/ keypads to activate locks …requires extra items e.g. cards/knowledge of codes …cards can be stolen/lost and used by others …codes can be forgotten/told to others Biometric tests to unlock doors …via keypads/Voice recognition …can be time-consuming to collect user data …needs to be updated regularly as biometric data can change …can be fooled in various ways e.g. recordings of voice Bolting computers to the desk …very secure …computers not easily moved to other locations …computers in fixed positions may be difficult to use Using special pens to mark their postcode/owner details onto the computer/device case …can allow retrieval of stolen items …can be a deterrent to thieves …can deface items preventing resale/reducing asset value Keeping windows shut/locked/barred - especially if on the ground floor …prevents thieves from entering …reduces access to fresh air Using CCTV video cameras to monitor computer rooms/corridors …allows surveillance of large areas …needs constant attendance Employing security guards to check passes …effective at preventing unknown people from accessing area …requires more employees so increases costs …relies on integrity/honesty of security guard Positioning screens so passers-by cannot see what is on the screen …prevents others knowing/discovering the password …position may be unsuitable for long term use Type in passwords out of sight of others …prevents others knowing/discovering the password …may not be easy to achieve in crowded office/position of keyboard.	**8**

June 2018 – P32

5 A company sells replacement windows for customers' homes. A salesman visits customers' homes to measure the windows. The salesman usually takes a company laptop on the visit. The salesman is away from the office most of the day. When the salesman is back in the office he has to type up a report on the visit and create quotations to send to the customers. He needs access to a variety of documents including those found on the internet. The salesman also needs to be able to communicate with customers in a variety of ways.

The company managers are considering replacing the laptop with a new smartphone for the salesman to take on the visit.

The salesman has made a comparison of the two devices.

Explain why the salesman has told the company managers that both devices are needed for the visits.

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Question 5 (Continued)

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Answer:

5	**Eight** *from e.g:* Laptop has these features required for sales Physical keyboard for typing emails/product but smartphone usually onscreen keyboard Large storage capacity/500GB for local storage of files whereas smartphone has only 32GB/limited file storage Access to external/online storage for file exchange/backup Laptop usually has an optical drive for s/w and product updates whereas the smartphone does not Laptop has greater compatibility of software than a smartphone/can use most features of e.g. office applications Smartphone has these features required for sales people when away from office Smartphone can be used for SMS/text messages Can make voice calls whereas a laptop cannot Smartphone always available/can be carried easily/unobtrusively/smaller than a laptop Smartphone can use 3G/4G whereas laptop is restricted to WiFi/cable Smartphone can be used for internet access by laptop/tethering of laptop to smartphone for internet access Smartphone is not as good at office tasks as a laptop Can connect more readily/to more services Size of device may not be an issue as salesman will use a car/drive to visit.	**8**

7 Telecommunication companies often prefer to use fibre optic cables to transmit data.

Discuss the benefits and drawbacks of using fibre optic cables for data transmission.

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Question 7

Answer:

7	**Eight** *from:* Can provide greater bandwidth to provide faster rate of data transfer Can carry thousands more connections c.f. electrical cable so not so many cables required Lower signal losses over distance so less need for amplifiers/repeaters so less maintenance Can span longer distances so is used to cross difficult areas/gaps/seas/oceans No interaction with other cables as resistant to electrical interference/ground currents ...can be used in areas of high electromagnetic activity No crosstalk with adjacent cables so no distortion of signals Lighter in weight so can be more suitable for use in aircraft No sparks produced if faulty/cut so safer in high risk areas Resistant to corrosion so less maintenance required Smaller cable size so can be used in confined spaces Difficult to 'hack'/listen/tap into so more secure Can go around corners/bends unlike laser beams Can be more expensive to install than copper cables Specialist test equipment is needed Specialist tools are required for joining optical fibres Physical damage is more likely to interfere with signal transmission compared to similar with copper cables Wildlife prefer the covering of optic fibres for nesting materials compared to those around copper cables Underwater fibre optic cables are more susceptible to chemical damage than copper ones e.g. hydrogen will degrade them Cannot have 90° corners unlike copper cables. *Max six for all positives or all negatives.* *1 mark available for a reasoned conclusion/opinion.*	**8**

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1 Video is streamed over networks and the internet at different bit rates. Fig. 1 shows a summary of the bit rates that are usually required for various video resolutions. Fig. 2 shows the bandwidths that are typically available over different mobile (cell) phone connections.

Output video resolution (pixels)	Bit rate (Mbits/s)
320 × 240	0.4
480 × 270	0.7
1024 × 576	1.5
1280 × 720	2.5
1920 × 1080	4.0

Fig. 1

Type of mobile connection to network/internet	Typical maximum bandwidth available for download (Mbits/s)
3G mobile connection	0.31
4G mobile connection	15
Bluetooth® 1.1 connection	0.5
Wi-Fi (IEEE 802.1g) wireless connection	54

Fig. 2

Question 1 (Continued)

Using all the information in Fig. 1 and Fig. 2, explain how the viewing experience of a streamed video displayed on a mobile (cell) phone screen of resolution 1024 × 576 pixels is affected by bit rate and available bandwidth.

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Question 1

Answer:

1	**Eight** *from:* The more available bandwidth on the connection the higher quality of video that can be streamed Use of a 3G connection to the internet limits video/streaming to low bit rate of 400 Kb/s Buffers not filled completely so video pauses/stops/jerky if frames not received fast enough Provides video of 320 × 240 pixels without apparent stuttering/buffering/ stop-start issues This will be a poor video/low definition video as seen on the 1024 × 576 screen Use of a 4G connection with higher bandwidth of c. 15Mbit/s allows video with higher bitrates to be viewed properly This is 1024 × 576 is possible and this is HD quality Highest bit rates of 19 / 30 Mbit/s allowing resolutions of up to 1920 × 1080 pixels Available/can be streamed over Wi-Fi (IEEE 802.1 g) wireless connections.... Which have a maximum of 54 Mbit/s 1920 × 1080 pixels will have to be downscaled for viewing on the smartphone screen Which may lead to artefacts and loss of quality.	**8**

3 Fig. 3 shows a switched network with computers at **A**, **B**, **C** and **D**.
S1, S2, S3, S4, S5 and S6 are switches. A message is being sent between computers at **A** and **B**.
The whole message is sent at once along the route shown by the arrows.

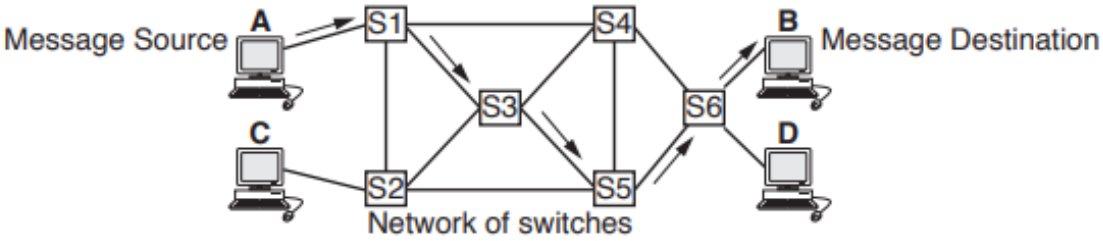

Fig. 3

(a) Explain, with reference to Fig. 3, why this method of sending a message by the route shown is often called 'store and forward'.

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Question 3, Part (a) (Continued)

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Answer:

3(a)	**Eight** *from:* S1 to S6 have their own storage devices for storing whole messages Message sent in its entirety from source to switch S1 ...S1 stores whole message on its storage device S1 connects to S3 and forwards whole message to S3 ...S3 stores whole message on its storage device ...message is deleted from S1 S3 connects to S5 and forwards whole message to S5 ...S1 stores whole message on its storage device ...message is deleted from S3 Process repeated between S5 and S6 where message is stored before forwarding to destination The source and destination of the message are not directly connected Message can be multiplexed with other messages on network Switches Method is called 'message switching'.	**8**

Question 3, Part (b)

(b) Describe **two** advantages of using the 'store and forward' method to send a message over this network.

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Answer:

3(b)	**Two** *from:* Improves/makes more efficient use of bandwidth because the data channels are shared among communication devices Network congestion can be reduced as messages can be stored temporarily at message switches Priorities may be used to manage network traffic Use of broadcast messaging/messages are delivered to multiple destinations makes more efficient use of network bandwidth Message can be stored until recipient decides to pick it up Process is transparent to applications the use it.	**2**

11 Discuss the benefits and drawbacks of using satellites for television and radio broadcasting.

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Question 11

Answer:

11	**Eight** *from:* Geographical area that can be covered is much greater than other broadcasting methods Costs are less over greater distances/areas... No need for terrestrial transmitters to homes Can cover difficult terrain more cheaply Allows greater bandwidth for data transmission... Higher definition for TV/bit rate for radio for higher quality broadcasts More TV/radio channels are possible due to greater capacity Requires users/viewers/listeners to have (suitable) receiving equipment ...broadcasters may have a limited audience if few people have satellite receivers ...need line of sight view to satellite to be able to receive ...need to be professionally installed which takes time and can be costly Satellite technology has a huge setup cost Satellites do not have an unlimited lifespan ...may become space junk when lifespan is over Repair of orbiting satellites is almost impossible Signals to ground can be subject to interference/blockage due to weather/other signals Significant delays in signal propagation/travel time of signals/distance from uplink to receiver can cause anomalies e.g. time differences of several seconds in transmissions. *Max six for all positives or all negatives.* *1 mark available for a reasoned conclusion/opinion.*	**8**

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4 Fig. 3 shows a diagram of interconnected computer networks that use internet protocol (IP) and packet switching to communicate. A large file is sent from network A to network H. Nodes B to G are routers used to connect the networks. During the sending of the file from network A, network I also starts to send a much larger video file to network H.

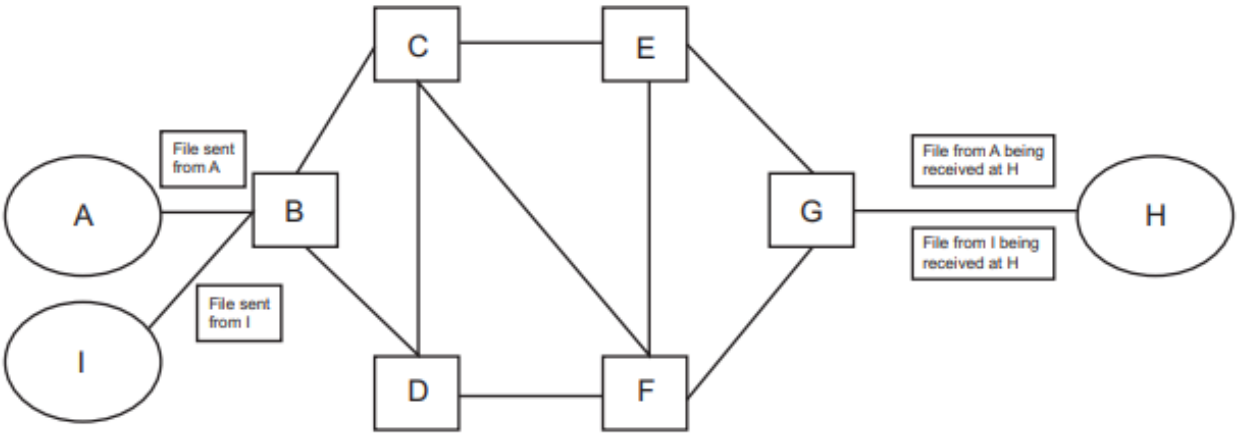

Fig. 3

(a) Explain, in detail with reference to the diagram, how the file from network A and the file from network I travel through the network from router to router and start to arrive at network H at the same time.

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Question 4, Part (a) (Continued)

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Answer:

4(a)	**Six** *from:* Each packet sent by network A takes a different route through the network Each packet has source/destination address stored in header Each router has a stored lookup table of IP addresses/routes to the destination (if known) Routing table is stored at control plane of router Used to choose next router/router to send packet to Static routes are pre-programmed to show route to destination B to C to E to G Dynamic routing protocols build up table of preferred routes between connected networks B to C to F to G if router E is inefficient/out of action/in heavy demand If destination is unknown router B will send packet to next known router, C or D If C/D router does not know destination to H then packet is sent onto next router, E or F.	**6**

Question 4, Part (b)

(b) Explain why router C does not always send the packets to router D.

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Answer:

4(b)	**Six** *from:* Router D may be not responding Router D may be in heavy demand Router D may have failed/be offline There may a policy set up in router C to over-ride the routing tables so that the packets are not sent to router D To enforce a QoS for specific services that take precedence over other packets Router C may have more than one set of routing protocols because it is connecting to several different networks at once Alternative routers may respond quicker/before router D/alternative routes are available sooner than via router D.	**6**

8 Evaluate the use of the infra-red method of data transmission in wireless communications.

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Question 8

Answer:

8	**Eight** *from:* Suitable for use in 'free-space' i.e. no physical connection medium such as cable or fibre Infra-red LEDs allow point-to-point optical commnciations Infra-red LEDs allow high data rates using laser technology Infra-red LEDs allow relatively inexpensive compared to other radio technologies Uses pulsing modulation/on-off signals which can restrict rates to low data rates in free space Suitable for short distance communication between devices (usually only maximum of a few metres) May not work relaibly when too close together Line of sight required so objects block the signals Not subject to interference as much as other radio technologies Has low power requirements so suitable for use in small/mobile devices/remote controls Can be more secure than other radio technologies as range is low/easily blocked by objects. *Max six for all positives or all negatives.* *1 mark available for a resoned conclusion/opinion.*	**8**

November 2018 – P33

3 Evaluate the use of Bluetooth® wireless technology for communication between devices.

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Question 3

Answer:

3	**This question to be marked as a Level of Response.** **Level 3** **(7–8 marks)** Candidates will evaluate, giving advantages and disadvantages of, a range of devices, in detail the use of Bluetooth® wireless technology for communication between devices. The information will be relevant, clear, organised and presented in a structured and coherent format. There will be a reasoned conclusion/opinion. Subject specific terminology will be used accurately and appropriately. **Level 2** **(4–6 marks)** Candidates will explain, with advantages and disadvantages, the use of Bluetooth ® wireless technology for communication between devices. For the most part, the information will be relevant and presented in a structured and coherent format. There may be a reasoned conclusion/opinion. Subject specific terminology will be used appropriately and for the most part correctly. **Level 1** **(1–3 marks)** Candidates will describe the use of Bluetooth® wireless technology for communication between devices. Answers may be in the form of a list. There will be little or no use of specialist terms. **Level 0** **(0 marks)** Response with no valid content. *Answers may make reference to e.g.* Bluetooth® has... ..a range of applications/uses for wireless communications between devices like phones/ headsets/speakers/ ..a range of applications/uses for control of communications between devices *Advantages:* Bluetooth® requires minimal setup e.g. just a few button presses and (possibly) a 4 digit code so is easy to use/setup or pair/bond devices c.f. other network types Bluetooth® is low energy technology so suitable for mobile devices Bluetooth® is standardised so easy to implement/most devices will connect readily Bluetooth® is standard in a range of devices e.g. smartphones, speakers, headsets Bluetooth® is not easy to intercept nor will it easily interfere with other device connections	**8**

Question 3

Answer (Continued):

3	*Disadvantages:* Bluetooth® is short-range Is affected by obstacles/walls that attenuate signals Drains battery power if range is at maximum Bluetooth® – enabled technology can be more expensive than non-enabled devices Bluetooth® has limited bandwidth.	

Question 6

6 A company selling goods online has a network which is configured to allow its web server, FTP server and email server to be accessible from the internet. The company was concerned that the network configuration exposed the whole LAN to security risks so has attempted to improve security by altering the configuration from that in Fig. 4 to the configuration shown in Fig. 5.

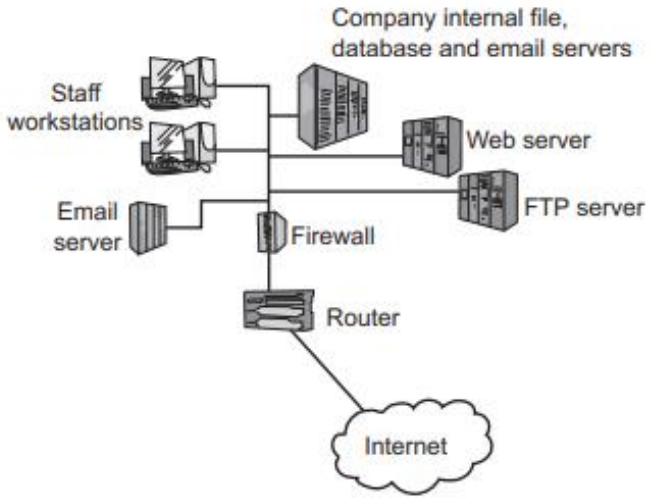

Fig. 4

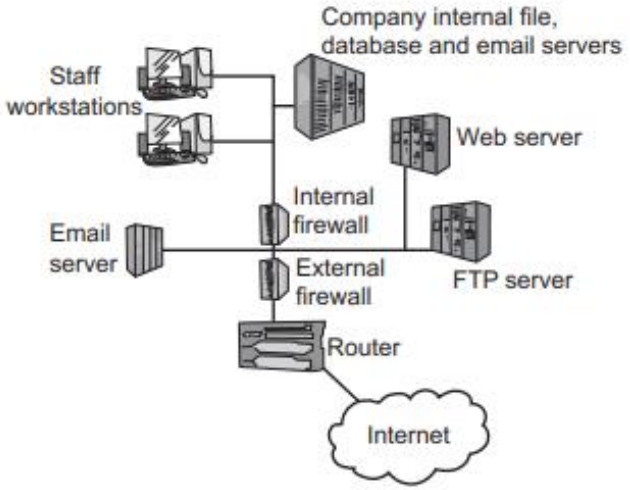

Fig. 5

(a) Explain how the network configuration has been altered in order to maximise security of the company file servers while still allowing access to the other services from the internet.

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Question 6, Part (a) (Continued)

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Answer:

6(a)	**Six** *from:* Installation of additional/two firewalls (to separate the servers from internal network) Installation of/configured a perimeter network/demilitarised zone/DMZ DMZ can be physical or logical subnetwork DMZ external node/computer system can only access the services in the DMZ and not the internal LAN The services accessible to external users are placed in the DMZ... ...email server and web server and FTP server Services for internal use are kept behind internal firewall so not accessible from the internet External firewall is the perimeter/front end and allows traffic destined for DMZ to pass Internal firewall is configured to allow traffic from DMZ to enter company LAN.	**6**

Question 6, Part (b)

(b) Explain, using the information from Fig. 5, why the additional firewall provides more security for the company network.

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Answer:

6(b)	**Four** *from:* The extra firewalls means that any attacker that gets past the first firewall would have to get past the second to access the company LAN An attacker could not be sure how many other firewalls would be found on the network One firewall is an external firewall and one is an internal firewall and could have different security The internal firewall security protects the data one LAN segment The external firewall security only has to deal with data from the internet The internal services are now protected by both firewalls.	**4**

March 2018 – P32

2 Analyse the impact of network bandwidth on video-conferencing.

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Question 2

Answer:

2	***Eight** from:* Bandwidth requirements are higher to allow more detail in video images Video-conferencing requires higher resolution video because there are often several people on screen at once Need to see facial features/body expressions of participants clearly One person to another (when video-conferencing) does not require high resolutions High bandwidth (of 2–4 Mbps) would deliver an (H720p) high definition image for multiple participants Low bandwidth (of 512 kbps) would be sufficient for one-to-one video-conferencing Low bandwidth does not allow high definition images so would not be able to properly see the faces of multiple participants High bandwidth would allow higher frame rates/30fps for smooth motion Limited/low bandwidth requires trade-off between resolution and frame rate Resolution priority for displaying slideshows/documents in detail Motion priority for displaying video presentations. *Max 6 for all positives or all negatives.* *1 mark available for a reasoned conclusion/opinion.*	**8**

3 Fig. 1 shows a diagram of interconnected computer networks that use internet protocol (IP) to communicate. A file is being sent as six data packets from network A to network H. Nodes B to G are routers used to connect the networks.

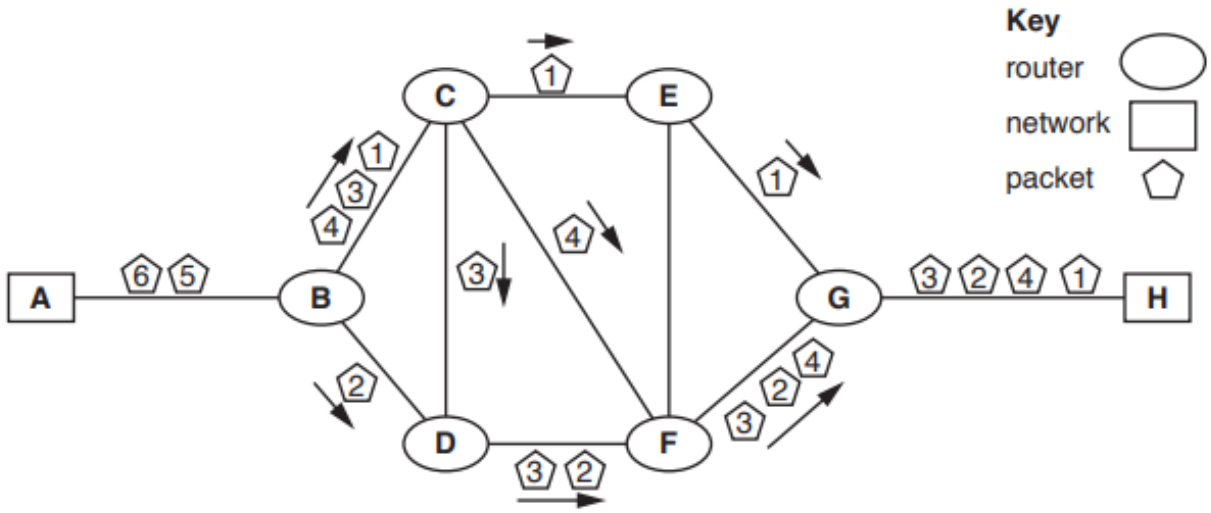

Fig. 1

(a) Explain why the packets arriving at network H are in a different order from when they were sent by network A.

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Answer:

3(a)	***Two** from:* Each packet takes a different route through the network Each router 'decides' which router to send it onto depending on other network traffic e.g. router A will send some packets to router C and some to D If next router is busy/unavailable If a packet is mis-sent/corrupt en route then re-transmission is requested from originating router Time taken along different routes is not the same Arriving at different times at network H.	**2**

Question 3, Part (b)

(b) Explain the role of the routers B to G in sending the packets from network A to network H.

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Answer:

3(b)	***Five** from:* Each router has a stored lookup table of IP addresses/routes to the next router/network Routing table is stored at control plane of router Routing table used to choose next router/router to which to send packet Static routes B to C to E to G are pre-programmed to show route to destination Dynamic routing protocols build up a table of preferred routes between connected routers/networks B to C to F to G if router E is inefficient/out of action/in heavy demand If destination is unknown router B will send packet to next known router/C or D If C/D router does not know destination to H then packet is sent onto next router/E or F.	**5**

9 There are a number of different types of protocols.

(a) PPP is a network protocol.

Describe what is meant by PPP.

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Answer:

9(a)	***Two** from:* *(PPP is)* Point to Point Protocol Used in (most) dial-up connections Has link monitoring capability/can log how many errors occur Can maintain multiple links and enable them to function as single link Provides authentication via password authentication protocol (PAP)/challenge-handshake protocol (CHAP) Requires a username/password to allow dial in to network.	**2**

Question 9, Part (b)

(b) Email is used to send and retrieve messages between email clients and email servers. One network protocol in common use for email access is Internet Message Access Protocol (IMAP).

Describe the features of IMAP that make it suitable for email access on smartphones.

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Question 9, Part (b)

Answer:

9(b)	***Eight** from:* Can use multiple email clients simultaneously Allows use of same email system on mobile devices and PCs at same time Changes on one device are reflected on other devices connected at same time Provides multiple mail boxes Can create/use folders/mailboxes on server Can copy messages Email clients stay connected to server Email messages downloaded as and when they arrive at server Provides faster response time to emails to recipient compared to POP3 Allows access to sections of message/partial messages/partial fetch Messages with attachments can be retrieved without downloading the attachment Can stream content as it is being retrieved Message state information available Uses flags stored on server to check whether message has been read/replied to/deleted Can be seen across connected devices Server-side searches can be carried out Email client can search server for email messages using user-defined criteria.	**8**

10 Evaluate the use of asymmetric-key and symmetric-key cryptography when encrypting data for electronic transmission between two people.

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Question 10

Answer:

10	This question to be marked as a Level of Response. **Level 3 (7–8 marks)** Candidates will evaluate in detail, giving both advantages and disadvantages of, the use of asymmetric and symmetric cryptography when encrypting data for electronic transmission between two persons. The information will be relevant, clear, organised and presented in a structured and coherent format. There will be a reasoned conclusion/opinion. Subject specific terminology will be used accurately and appropriately. **Level 2 (4–6 marks)** Candidates will explain the use, giving both an advantage and disadvantage, of asymmetric and symmetric cryptography when encrypting data for electronic transmission between two persons. For the most part, the information will be relevant and presented in a structured and coherent format. There may be a reasoned conclusion/opinion. Subject specific terminology will be used appropriately and for the most part correctly. **Level 1 (1–3 marks)** Candidates will describe, with a least one advantage/disadvantage of, the use of asymmetric and symmetric cryptography when encrypting data for electronic transmission between two persons. Answers may be in the form of a list. There will be little or no use of specialist terms. **Level 0 (0 marks):** Response with no valid content. ***Answers may make reference to e.g.:*** ***symmetric-key*** cryptography: *Advantages:* shares the same/related key with sender and receiver... ...process is relatively fast ...used on solid state drives to encrypt/decrypt data as it is written/read to/from disk. *Disadvantages:* ...keys must be kept secret from others ...sharing keys between sender/ recipient is a security issue ...if key is compromised both sender and recipient are at risk.	**8**

Question 10

Answer (Continued):

10	***asymmetric key*** cryptography (public key) *Advantages:* uses different keys to encrypt and decrypt ...public key is known to all, but private key is known only to recipient ...only private key must be kept secret …anyone can use public key to encrypt ...only recipient can decrypt ...keys are not shared ...so is very secure ...if private key compromised, only senders data is at risk as any other data sent to others is encrypted with a different public key. *Disadvantages:* ...process is relatively slow... ...so not suitable for e.g. hard disk encryption on-the-fly.	

June 2019 – P31 & P33

5 Describe how data is transmitted using fibre optic technology.

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Answer:

5	**Six** *from:* Electrical signals converted to light for transmission / converted back to electrical signals after transmission LED / laser (at node) sends / transmits a light beam / electromagnetic wave along the fibre Data is modulated onto a carrier wave Optical fibre connects the nodes / devices ADC / DAC are used to modulate / demodulate the data onto / off carrier wave Laser is used where longer distances are to be covered LED is used where shorter distances are to be covered as it is cheaper than laser Lasers produce coherent light which can allow greater bandwidth Receiver is photo detector to convert light into electricity Uses indium gallium arsenide in photo detector.	**6**

9 Evaluate the use of physical security in combatting IT crime.

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Question 9

Answer:

9	**Command word: Evaluate: discuss the importance of, weigh up, the advantages and disadvantages, judge the overall effectiveness, weigh up your opinions.** *This question to be marked as a Level of Response.* **Level 3 (7–8 marks)** Candidates will evaluate, giving advantages and disadvantages, of at least three ways in which physical security can be used in combatting IT crime. The information will be relevant, clear, organised and presented in a structured and coherent format. There will be a reasoned conclusion / opinion. Subject specific terminology will be used accurately and appropriately. **Level 2 (4–6 marks)** Candidates will explain giving advantages and disadvantages of at least two ways in which physical security can be used in combatting IT crime. For the most part, the information will be relevant and presented in a structured and coherent format. There may be a reasoned conclusion / opinion. Subject specific terminology will be used appropriately and for the most part correctly. **Level 1 (1–3 marks)** Candidates will give advantages / disadvantages of using physical security in combatting IT crime. Answers may be in the form of a list. There will be little or no use of specialist terms. **Level 0 (0 marks):** Response with no valid content.	**8**

Question 9

Answer (Continued):

	Answers may make reference to e.g.: Physical barriers such as wall / doors / bars / use of floors other than ground floor which are cheap and easy to make use of / make use of existing resources which lowers costs Use of CCTV which can be placed overtly to deter unauthorised persons just by their presence or by a warning / notice that watching is occurring / can be cost effective as a deterrent Video surveillance can be used to watch large areas with few staff Physical presence of guards / security staff shows persons that a security system is in operation ... can deal with issues quickly / immediately Security lighting / automatic lights / sensor-controlled lights can illuminate when persons present to act as deterrent / highlight intruders / warn intruders that they have been seen and these have low cost if e.g. solar powered Computer devices can be easily / cheaply / quickly fixed / attached to large objects / shelving to deter theft Physical locks require keys that may be lost / key fobs etc may be lost or stolen / given to unauthorised persons Combinations to locks can be forgotten	
9	Locks can be left unlocked in error Physical keys can be copied / given to unauthorised person Physical combinations to locks can be compromised by watching as lock is accessed Security staff / guards may not be alert / honest / in place when required.	

June 2019 – P32

2 Lasers can be used to create a data link between devices without using cables.

(a) Describe **two** applications for this method of data transmission.

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Answer:

2(a)	**Two** *from e.g.:* Between spacecraft (in orbit through vacuum) To connect sites across roads / other barriers not owned by sender / receiver Provide (temporary) network connection in e.g. disaster areas where cabling is not possible.	**2**

(b) Describe **one** drawback of this method of data transmission.

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Answer:

2(b)	**One** *from:* Short range only in atmosphere due to dispersion of (light) beam by particles in atmosphere Accurate aiming of (light) beam is more / may be more difficult Difficultly in connection is increased if sender / receiver are moving Blocked by objects / weather in path of (light) beam / line of sight.	**1**

6 A packet switched network has routers at nodes labelled A, B, C, D, E, F, G and H. Each router stores its own 'routing table' which shows how it is connected to the other routers.

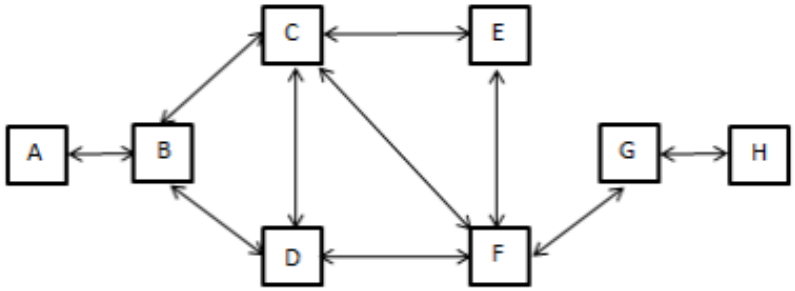
Router	Connected to routers:			
A	B			
B	A	C	D	
C	B	D	E	F
D	B	C	F	
E	C	F		
F	C	D	E	G
G	F	H		
H	G			

(a) Complete the diagram by drawing routers C, D, E, F and G with connection lines to show how the routers are inter-connected to communicate with each other.

[3]

Question 6, Part (a)

Answer:

6(a)	A suitable diagram could be:  **Three** *from:* All correct labelled boxes for routers C, D, E, F, G All correct connecting lines between boxes / routers All connecting lines shown as double-ended arrows.	**3**

Question 6, Part (b)(i) and (b)(i)

Router A regularly sends out packets to check that router H is reachable. When H receives a packet from A it sends a packet back to confirm that it is reachable.

Assume that each router takes zero time units to receive, process and resend a packet and that each packet takes six time units to travel from one router to the next.

(b) (i) Describe the shortest route that a packet can take from router A to router H.

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Answer:

6(b)(i)	(A, B), C/D, F, G, (H).	**1**

(ii) Calculate the shortest time taken for router A to receive an acknowledgement from router H confirming that H is reachable.

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Answer:

6(b)(ii)	**Two** *from:* shortest route is 5 hops so: 5 × 6 = 30 (time units) × 2 for return, 30 × 2 = 60 (time units).	**2**

Question 6, Part (c)(i) and (c)(ii)

(c) (i) Assuming that the packets visit each router only once, calculate the longest time it could take for router A to receive an acknowledgement from router H confirming that H is reachable.

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Answer:

6(c)(i)	**Two** *from:* longest route takes 7 hops so: 7 × 6 = 42 (time units) × 2 for return = 84 (time units).	**2**

(ii) Describe the route that the packets would take.

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Answer:

6(c)(ii)	**One** *mark for all correct:* (A, B), D, C, E, F, G (H).	**1**

Question 6, Part (d)(i) and (d)(ii)

(d) An additional router, J, is to be added to reduce the time for packets to travel from router A to router H to a minimum. However, no further connections can be directly made to routers A and H.

(i) Describe where J would be placed to reduce the travel time to a minimum.

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Answer:

6(d)(i)	Between B and G.	**1**

(ii) Calculate the new minimum time that it would take for A to receive an acknowledgement that H was reachable.

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Answer:

6(d)(ii)	**Two** *from:* 4 hops × 6 = 24 × 2 = 48 (time units).	**2**

7 Computing devices use network interface cards.

(a) Describe the role of a network interface card.

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Answer:

7(a)	**Four** *from:* Provides access (for protocols) to physical / wireless transmission medium Creates the protocol stack (using its electrical components) Allows communications between LANs / WANs (using the protocols it has created) Provides low level addressing at MAC level Works at physical and data level of OSI model / OSI layer 1 and 2.	**4**

Question 7, Part (b)

(b) Describe how a network interface card is involved in the sending and receiving of data.

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Question 7, Part (b)

Answer:

7(b)	**Seven** *from:* Accepts data from CPU via internal buses Converts parallel data stream to linear / serial data stream and vice versa for transmission / after reception to / from transmission medium Data is sent / received in frames *When sending:* NIC is notified that frame has been created by OS in a buffer NIC accesses / reads buffer / memory directly by DMA NIC determines address and creates data frame NIC transmits completed frame to transmission medium NIC notifies OS that frame has been sent *When receiving:* NIC monitors transmission medium for frames NIC reads frame from transmission medium into buffer using DMA NIC checks frame contents and calculates checksum to verify integrity of data NIC interrupts host OS to indicate that a frame has arrived *Max. 6 if all sending or all receiving.*	**7**

10 Homer uses headphones to listen to the audio from movies playing on his television. Homer is trying to decide whether to use Bluetooth or cables to connect his headphones to the TV while he watches the movies.

Choose, with reasons, the most appropriate of these methods so that Homer can hear the soundtrack while watching movies.

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Answer:

10	**Five** *from:* Cable ensures an uninterrupted connection to the TV Cable does not suffer from dynamic range limitations as does Bluetooth transmission so (action) movies do not have same impact Cable does not suffer from limited frequency ranges as does Bluetooth transmission so movie experience can be spoiled Cable does not need power in the headphones so can be used without preparation when watching movies / unlimited by battery going flat Bluetooth can suffer from interference from other wireless devices which can spoil the sound (effects) from movie Bluetooth takes time to process so video and audio are out of sync / lip sync issues spoil the movie experience Bluetooth headphones can be larger / uncomfortable / heavy due to battery requirements to movie watchers who get tired of using them before end of movie Bluetooth headphones do not work if battery is flat / needs charging, so cannot listen to sound of movie.	**5**

11 Evaluate the use of anti-virus software and anti-spyware in combatting IT crime.

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Question 11

Answer:

11	This question to be marked as a Level of Response. **Level 3 (7–8 marks)** Candidates will evaluate, giving both advantages and disadvantages, of the use of anti-virus software in combatting IT crime. The information will be relevant, clear, organised and presented in a structured and coherent format. There will be a reasoned conclusion / opinion. Subject specific terminology will be used accurately and appropriately. **Level 2 (4–6 marks)** Candidates will explain both advantages and disadvantages, of the use of anti-virus software in combatting IT crime. For the most part, the information will be relevant and presented in a structured and coherent format. There may be a reasoned conclusion / opinion. Subject specific terminology will be used appropriately and for the most part correctly. **Level 1 (1–3 marks)** Candidates will describe the use of anti-virus software in combatting IT crime Candidates will explain advantages / disadvantages of the use of anti-virus software in combatting IT crime Answers may be in the form of a list. There will be little or no use of specialist terms. **Level 0 (0 marks):** Response with no valid content. *Answers may make reference to e.g.:* **Advantages** Removes virus / malicious software that could delete / edit / destroy data Protect against spyware to prevent theft of confidential / personal information thus preventing unauthorised access to bank accounts leading to financial loss Can help / may protect against spam / phishing emails thus preventing the divulgence of confidential / personal information Protect against identity theft that may be a result of stolen confidential / personal information Protect against redirection of automatic payments ('stealware' or 'chargeware / affiliate fraud') to help prevent 'click fraud' Can help protect / stop unwanted / unauthorised use of computer for crypto-currency mining	**8**

Question 11

Answer (Continued):

11	**Disadvantages** Anti-virus software must be kept up to date in order to combat the most recent viruses / malicious software Anti-virus software must be running all the time so places a performance 'overhead' on a computer system that may make the system slow / sluggish / unresponsive Anti-virus software will not detect all / every instance / type of malicious software so perpetrators can find ways around it ...infected websites use malicious code which is often not picked up by anti-virus software.	

13 Many countries have enacted laws to govern the use of personal data.

Analyse the need for data protection laws.

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Question 13

Answer:

13	**Eight** *from e.g.:* *Data protection laws are needed to address these concerns e.g.:* Personal data is stored on computer systems / in databases which may not be secure Databases are easily edited / searched / accessed (remotely) so data can be seen / manipulated Data can be easily / quickly cross-referenced / correlated by computer systems Computer systems can be networked so data can be accessed from many different locations / shared more easily between users Control over shared data is more difficult to maintain Accuracy of the information may be compromised / difficult to maintain when shared Data can be easily copied to other media / stolen without any trace of the action Data about individuals can be stored without their knowledge so infringing their privacy Keeping records of who / what / when data is accessed are difficult to maintain unless enforced by law.	**8**

November 2019 – P31 & P33

2 (a) Describe **three** different networking protocols that would be used for data transfer on a LAN.

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Answer:

2(a)	*Three protocols from e.g.:* FTP/file transfer protocol for uploading data/files/pages to server HTTP/hypertext transfer protocol for accessing web pages HTTPS/hypertext transfer protocol secure for secure data transfer SMTP/IMAP/POP to send/receive emails TCP/IP for packet transmission SSH for secure access to a server/another workstation SFTP for secure method of uploading data to a server SMB for transferring files to a file server TELNET to connect computers to a switch/router.	**3**

Question 2, Part (b)

A company has devices that use WiFi to connect to its LAN.

(b) Describe how data is transmitted between a device and a wireless access point.

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Answer:

2(b)	*Four from:* Uses radio waves in 2.4 GHz/5 Ghz frequency ranges/(900 MHz and 3.6/60 GHz frequency bands) Data frames are modulated onto carrier wave Spread spectrum used for higher power levels Two channels used for full duplex exchange of data/most WiFi is half-duplex WiFi network uses SSID to identify itself Access point and device must be connected to same WiFi network/SSID to be able to exchange data Data is encrypted for security during transmission Devices must use IEEE 802.11 protocols/standards IEEE 802.11 has a number of variants a/b/g/n/ac(/ad/ah/aj/ax/ay/az) (must have 3 to gain this extra mark) 14 channels on 2.4 GHz which are 5 MHz spaced/device uses channels spaced apart to reduce channel interference.	**4**

Question 2, Part (c)

(c) Some of the company's devices can connect to other devices using Bluetooth instead of WiFi.

Compare and contrast the use of Bluetooth with WiFi for data transfer.

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Question 2, Part (c)

Answer:

2(c)	*Candidates may refer to e.g.:* ***Two** similarities from:* They are both communication systems Both use wireless technology Both have more limited range than cabled networks Both have limited bandwidth compared to cable networks ***Four** differences from:* Bluetooth has a shorter range than WiFi Bluetooth is restricted by solid objects/barriers/walls whereas WiFi can penetrate most barriers to some extent Bluetooth has a lower bandwidth than WiFi Bluetooth requires 'pairing' of devices whereas WiFi (often/usually) requires a full log in procedure Bluetooth data transfer is 'one to one' whereas WiFi facilitates communication between several devices.	**6**

6 Discuss the benefits and drawbacks of using ethernet cables containing copper within a computer network.

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Question 6

Answer:

6	*Command word: Discuss: give important arguments for and against. Often requires a conclusion.* This question to be marked as a Level of Response. **Level 3 (7–8 marks)** Candidates will evaluate in detail the benefits and drawbacks of the use of copper cables The information will be relevant, clear, organised and presented in a structured and coherent format. There may be a reasoned conclusion/opinion. Subject specific terminology will be used accurately and appropriately. **Level 2 (4–6 marks)** Candidates will explain the benefits and drawbacks of the use of copper cables For the most part, the information will be relevant and presented in a structured and coherent format. There may be a reasoned conclusion/opinion. Subject specific terminology will be used appropriately and for the most part correctly. **Level 1 (1–3 marks)** Candidates will describe at least one benefit and at least one drawback of the use of copper cables Answers may be in the form of a list. There will be little or no use of specialist terms. **Level 0 (0 marks):** Response with no valid content.	**8**

Question 6

Answer (Continued):

	Answers may include reference to: *Benefits:* Flexible so can be installed almost anywhere/can use 'tight' bends Can run electrical power along copper cable/Ethernet cable Can supply power to remote devices e.g. cameras high on buildings do not need separate power supply Costs of installation are less than for fibre optic cables NICs that use copper connections are cheaper to buy than those that use e.g. fibre optic Can provide higher bandwidths than wireless/WiFi Harder to hack into compared to WiFi *Drawbacks:* Can be subject to electrical interference Must not be run next to mains power cables Costs of installation are more than for wireless/WiFi Cannot provide as high bandwidths as fibre optic	
6	Break/lose contact/connection more frequently than fibre optic cables Easier to connect into by unauthorised users More of a safety/tripping hazard than WiFi.	

7 **(a)** Describe the **benefits** of using back-ups to prevent loss of data from computer systems.

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Answer:

7(a)	***Three** from:* Rapid access to (lost/removed) data/files Protection of data/files against power loss/failure of main system Protects against failure of storage system/hard disk Protects against loss of data from viruses/malware Protects against failure of OS.	**3**

Question 7, Part (b)

(b) Describe the **drawbacks** of using back-ups to prevent loss of data from computer systems.

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Answer:

7(b)	***Three** from:* Backups will store malware as well as safe data Backups will not remove malware Backups will restore data to time before malware infection but latest data will be lost Backups may not store up to date data if run during office/use hours Backups take snapshot of data which may change soon after backup is run so some data may not be backed up Backups can be stolen in their entirety If not encrypted all data can be stolen/accessed Backup windows should use system downtime which may be limited to out of hours' time System performance is reduced when backups are being carried out Restoration of data after malware infection can be laborious and time consuming Cost of extra hardware/storage may be excessive.	**3**

8 A school uses a proxy server to distribute web pages to work stations.

Describe the role of this proxy server.

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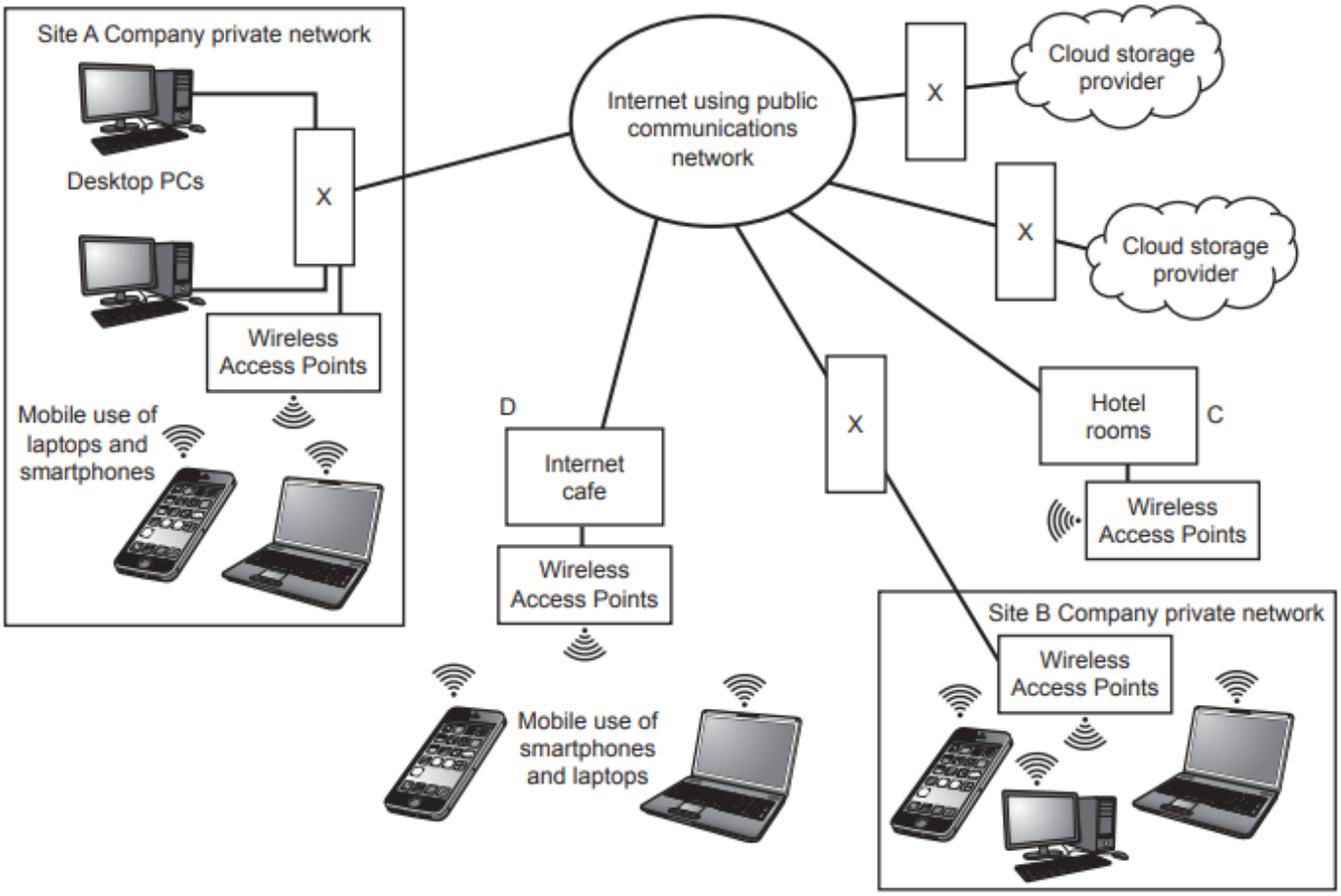
Answer:

8	**Six** from: Acts as gateway between LAN and WAN/internet Allows use of multiple (internal) IP addresses through one (external) IP address on internet Many computing devices/computers can be used through one internet connection Presents single IP address to exterior networks/internet (as number of external IP addresses is limited) Acts as a central device/node for logging/monitoring of internet access/activity Acts as a central device/node for filtering of internet access/activity Controls/requires username and password for internet access/activity Prevents access to inappropriate material/activities Acts as a cache for frequently used remote resources Reduces access times/network traffic over internet connection.	**6**

9 A company has two sites, A and B. Its staff work in either of the two sites and can access their files offsite because the company uses cloud computing technology for storing files.
The connections at the locations marked X provide security for the company's data.



Question 9, Part (a)

(a) Explain the role of the hardware and software that would be at locations marked as X.

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Question 9, Part (a)

Answer:

9(a)	*Eight from:* Anti-malware/virus/spyware software to protect against viruses and spyware. Firewall (software or hardware) to help to prevent unauthorised access to company network Firewall to help to prevent unauthorised access to files stored by cloud storage provider Only allow access to company devices/laptops/smartphones Firewall to enforce company security polices Firewall to interrogate data packets entering/leaving company networks/cloud storage providers Firewall works by comparing contents of packets with predetermined/user defined rules Router to direct data packets to/from internet from/to company network/Cloud storage provider Router maintains database/list/table of IP addresses to forward packets Router updates list from other routers as addresses become known to it Router ranks entries in table according to probability of being correct address for packet to take on its route to destination Router maintains list/table of other routers to send packet if route is unknown. X should use encryption to secure the data for transmission Passwords and user IDs should be required by the access/firewall software before allowing devices to connect/access. *For 8 marks, must have at least 1 mark from each of firewall, router and encryption.*	**8**

Question 9, Part (b)

(b) Explain why staff are discouraged from accessing their files from locations C and D.

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Answer:

9(b)	*Four from:* Locations B and C are open to the public/any device can connect so there is no secure connection at these locations Data may not be encrypted Location B could be used by hackers using Man in Middle (MIM) to route data through hacker computer Location B may be susceptible to fake/spoof/unauthorised wireless access points/connections Location B may be susceptible to intercepting wireless signals from company devices as there is no check on users of cafes/can sit anywhere without reason/identification.	**4**

November 2019 – P32

6 Describe the benefits of using lasers to transmit data between devices.

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Answer:

6	**Six** *from:* Can transmit data long distances along thin fibre optic cables Laser light is coherent so is not easily lost by dispersion Can carry vast amounts of data/implement very high bandwidths for data transmission Can be used in free space/just air so no need for cables Can be used in a vacuum so can be used between spacecraft Immune to electromagnetic interference Increased security as difficult to intercept in fibre/free space No licence to use is required (for use in free space) in most areas of the world Can be used to power devices in free space.	**6**

8 A bank stores details of customer accounts on its computer system. Customers and staff can access the accounts by logging in to the bank's website.

(a) Describe the security methods that could be used to ensure that the person logging in is authorised to do so.

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Answer:

8(a)	**Six** *from:* Use of user ID with password/PIN known only to user Request random selection of three of the digits of password/PIN Transaction authentication number sent to customer/generated by code machine held by customer or by number on screen/sent to cell phone of customer … … OTP/TAN is entered after user ID/password/PIN as next level of authentication … … OTP/TAN checked against list issued to/held by customer Use of one-time password generated by a security token Multi-factor authentication using tokens/sequence of characters Use of security questions/memorable words plus example Use of biometrics such as fingerprint/retinal scan Query use of different devices to log in.	**6**

Question 8, Part (b)

(b) The bank insists that its staff use a VPN when accessing the accounts from outside the bank's intranet.

Describe the network protocols that could be used by this VPN.

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Answer:

8(b)	**Six** *from:* IP security (IPsec) encrypting the data in the packet/encrypting entire packet Layer 2 Tunnel Protocol (L2TP) and IPsec where L2TP creates the tunnel while IPsec does the encryption Secure Socket Layer/SSL creates handshake system in conjunction with Transport Layer Security/TLS Point-to-Point Tunnelling Protocol/PPTP to create a tunnel and encapsulate the data packet An additional protocol will handle the encryption, e.g. TCP Secure Shell (SSH) SSH will create the tunnel and carry out the encryption of the tunnel (not the data).	**6**

10 Describe the effect of bit rate on the quality of streamed video.

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Answer:

10	**Four** *from:* Bit rate represents the amount of information/data that is stored per unit time in the streamed/recorded video Bandwidth of available connections determines bit rate that can be used for the video If transmission medium does not have sufficient bandwidth to carry the required bit rate the video will stall/be jerky/impose constant buffering ... and reduce the viewer's quality of experience of the video Video can be sampled at different bit rates/compressed to different bit rates Low bit rates produce video that lacks detail/is pixelated/shows motion in jerky steps The more bits that are used the higher the quality of the video e.g. ... 16 kbit/s is suitable only for video phone applications as detail is lacking/any significant movement pixelates the image ... 2.5 Mbit/s is suitable for low quality internet streaming ... 9.6 Mbit/s is DVD quality ... 8 to 15 Mbit/s is HD quality ... 40 Mbit/s will allow 1080p/Blu-ray disc quality for the video.	**4**

March 2019 – P32

7 Evaluate ways of combatting spyware.

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Question 7

Answer:

7	*Command word: Evaluate: discuss the importance of, weigh up, the advantages and disadvantages, judge the overall effectiveness, weigh up your opinions.* **Eight** *from:* Use of anti-spyware software will prevent spyware being installed May not detect spyware already installed May not detect spyware disguised as legitimate feature of another program/application Use of antivirus software – will detect and remove some spyware but not all, so has limited effectiveness when used on its own Real time scanning of incoming programs/applications/data can provide protection by blocking spyware from entering the system provided the spyware is recognised/in its database/can be analysed to be spyware Dedicated anti-spyware can detect and remove spyware provided all areas of system are regularly scanned Lists of spyware must be up to date Options may include option to manually delete files if anti-spyware is 'uncertain' of status of detected file/data Spyware may resist attempts to be deleted/uninstalled… May recreate another running process to reinstall itself once deleted by anti-spyware software Using alternative web browsers may prevent spyware being installed as some are more vulnerable than others… Web browsers are not designed to detect spyware Using reputable sources for download of software may help prevent spyware being installed Reputable sources can be 'infected' Use of combination of methods is most successful but takes awareness and time to implement Using a firewall to prevent spyware from returning data to the spyware source *One mark is available for a valid reasoned opinion/conclusion.*	**8**

10 An international organisation provides communication services over the internet. It enables customers to communicate messages confidentially between their offices in different countries.

It uses message, circuit and packet switching technologies for the communications.

Describe the differences between these three technologies as used in communicating these messages.

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Question 10

Answer:

10	**Eight** *from:* Packet switching breaks the message into discrete data packets whereas message and circuit may not do so Packet switching can introduce delays as packets may travel via different routes whereas message and circuit switching do not Packet and message switching make more efficient use of the capacity of the transmission medium than does circuit switching Circuit switching keeps the circuit connected for the whole of the duration of the transmission whereas message and switching do not Circuit switching uses the full bandwidth of the transmission medium whereas message and packet switching do not Circuit switching can guarantee a higher quality of service compared to the other methods Message switching can be less secure because messages are stored (temporarily) at nodes Circuit switching can guarantee a higher level of security of data compared to the other methods Others can use the same communication channel when packet switching is used whereas this is not possible when message and circuit switching is used.	**8**

June 2020 – P31 & P33

[Only Part (b) of Question 2 is relevant to "Networks"]

2 Ultra-high definition television is available from video streaming services over the internet.

(a) Describe the features of ultra-high definition television systems that improve the viewing experience.

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Answer:

2(a)	*Three from:* UHD has resolution of 4 times the number of pixels as HD/3840 × 2160 pixels (8.29 megapixels) v. 1920 × 1080 pixels (2.07 megapixels). UHD has resolution of 4K/4096 × 2160 pixels. UHD has resolution of 8K/7680 × 4320 pixels (33.18 megapixels)/16 times HD. Increased dynamic range compared to HD. Increased colour depth compared to HD. More LEDs in a given area on screen increase the resolution so there is more detail.	**3**

Question 2, Part (b)

(b) Analyse how the different types of transmission media used by internet service providers affect the availability of ultra-high definition television to their customers.

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Question 2, Part (b)

Answer:

2(b)	*Eight from e.g.:* Internet bandwidth of c.25 megabits/sec is required. Bandwidth required for UHD is not available to all customers/from all internet providers. Satellite transmissions/signals can provide required bandwidth. Reduced number of channels will be available unless new satellites are brought into service. Wireless/mobile telephone/4G networks have restricted bandwidth so cannot provide ultra HD. Introduction of 5G will make ultra HD available but will require new phones. Copper cable networks can provide bandwidth/up to 100 Mbit/s as Cat 5 ethernet/Cat 6 1 Gbit/s. Copper telephone cabling can provide ultra HD. Distance from exchange is limited as bandwidth reduces over distance. Fibre optic cables can provide high bandwidth (10 Gbit/s). Cost of use of fibre to home/installation to home is high. Fibre to cabinet (FTC) may provide UHD to more homes. Fibre allows much longer cable runs so may reduce installation costs over long distances from exchange to home.	**8**

4 A company is concerned that their personnel files may be viewed and used by unauthorised people. The company uses access rights (permissions) to protect their files when they are stored on their network and encryption when the files are sent to other companies by email.

(a) Explain how the use of different access rights (permissions) applied to files can be used to control access to files.

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Question 4, Part (a)

Answer:

4(a)	*Six from:* Different access rights/permissions can be given to different individuals/groups of individuals. Set up as Access Control Lists. Works on files/folders/directories. Permissions on folder/directory may be cascaded down to files contained within. Files within a folder/directory do not (necessarily) have same permissions as folder/director. If a permission/access right is not explicitly set, the right is denied. Read permission allows only viewing of file/directory/folder. Write permission allows modification of files/deletion/creation/renaming of files (within folder/directory). Execute permission allows file to run/executed. Permissions must be set/mandatory if OS is able to run/execute file for user.	**6**

Question 4, Part (b)

(b) Describe the advantages of the different encryption methods for protecting files when sending them over public telecommunications systems.

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Question 4, Part (b)

Answer:

4(b)	*Six from:* *Advantages of symmetric:* Symmetric uses keys/same keys for encryption and decryption so that must be shared to access the data so sharing of keys (also) has to be secured. Symmetric can be less secure because keys have to be shared/confidentiality of shared keys cannot be guaranteed. Can be very/more secure as (can) use (fixed-size) block encryption rather than encryption of bits/multiple rounds of encryption (which encrypts the encrypted block over and over). Keys have no special properties so are simple to generate. *Advantages of asymmetric:* Asymmetric uses public keys which can be accessed by anyone so no need to send key to specific user. Asymmetric uses a private/confidential key (known only to owner) so is (very) secure/data can be transferred without danger of public access. Key size is large/1024 to 2048 bits so security is high. Keys are reusable saving time/cost for owner.	**6**

6 Telecommunication companies are using fibre optic cables to supply internet services direct to people's homes because fibre optic cables are cheaper than copper cables.

(a) Explain the reasons, other than cost, why companies prefer to use fibre optic cabling.

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Answer:

6(a)	*Four from:* Can use long runs/lengths of cable compared to copper cables. Low signal loss over long distances. Greater tensile strength than copper. Not susceptible to electrical interference. Not susceptible to weather/environmental damage. Can provide very high bandwidth/internet speeds for customers.	**4**

Question 6, Part (b)

(b) Describe **three** disadvantages of using fibre optic cables.

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Answer:

6(b)	*Three from:* Difficult/require special equipment to splice/join if broken. Loss of signal/light at joins. If bent too much (beyond their limited physical arc) they will break. Special test equipment is often required for testing. Highly susceptible to physical damage/being cut or broken during construction/renovation/building/disturbance works. Data transmission losses often occur when wrapped around curves with small radius.	**3**

9 Describe the security issues that may arise when computers are networked.

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Answer:

9	*Six from e.g.:* Data can be lost/stolen by unauthorised users/hackers using gaining access to storage devices. Data can be stolen by interception of network traffic/capturing of IP packets. Valid user accounts can be abused/accidently cause data loss/damage. Malicious attacks with viruses/trojans/malware that damages/deletes/alters data. Misuse of resources by (unauthorised) persons/devices. Eavesdropping on other users' activities can enable theft of data/ID. Failure of hardware/software may expose data to loss/theft/damage. No need to have physical proximity to computer to access/can access systems remotely.	**6**

12 List **five** principles that should be included in a data protection act.

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Question 12

Answer:

12	*Five from:* Key contents of a Data Protection Act include: 1 Personal data should be collected and processed fairly and lawfully. Data subject should be informed about the data being collected. Data subject should be asked for permission to collect it. 2 Personal data can be held only for specified and lawful purposes. Data subject should know why data is collected/stored. Law is broken if data is used for other purposes. 3 Personal data should be adequate, relevant and not excessive for the required purpose. Only data that is needed can be stored. 4 Personal data should be accurate and kept up-to-date. Wrong/inaccurate data must not be stored. Wrong/inaccurate data should be corrected. 5 Personal data should not be kept for longer than is necessary. Data must not be kept forever/unreasonable lengths of time/must be destroyed when no longer needed. 6 Data should be processed in accordance with the rights of the data subject. Data subjects can inspect the data held about them. Data subjects can insist that incorrect data is amended.	**5**

June 2020 – P32

1 A company has a local area network (LAN) that can be accessed by its staff using their desktop computers, laptops and mobile devices. The desktop computers use a wired connection but the laptops and mobile devices connect via wireless access points (WAPs).

Describe the drawbacks of using WAPs to access the network.

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Question 1

Answer:

1	*Eight from:* Maximum number of clients (usually) (voluntarily) restricted (to e.g. 100–200). Number or transmitters/radios/e.g. 4 radios in access point restricts number of clients. Range can be restricted by obstacles/materials that obstacles are made of. Range can be restricted by the height of placement of access point. Range can be restricted by the positioning/direction of antenna(s). Range can be restricted by the presence of other electronic devices in vicinity. Limited number of frequencies are available for data transmission. The number of frequencies available varies in different jurisdictions to avoid interference. Large numbers of access points on the same/overlapping frequencies can interfere with each other. Data transmission speed/bandwidth is usually lower/less than wired connection over long distance. Bandwidth of wired can still be high/1000 Mbits/s at 100 m but wireless usually cannot achieve this. Wireless access points have increased security considerations c.f. wired connections so must use password/security keys to connect/join to the access point. Enforced use of passwords can slow down work/frustrate staff when connecting is slow/key is forgotten. Wireless transmissions can be more easily intercepted so data must/should be encrypted. If network key is stolen/publicised, then the key must be changed so every device must reconnect with new key. Additional login details required for guests/temporary workers add to processing requirements in WAP. Security measures add an overhead/slow down processing/data transfer speed. Use of access points may require additional physical/shielding/use of Faraday cages in structure of building to prevent interception of transmissions which increases costs/add structural design complexity/restricts use of mobile connections by users inside the cage.	**8**

6 Describe how a digital television signal is broadcast from a satellite to a receiver for display on a television set in a home.

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Question 6

Answer:

6	*Eight from:* Satellite is in geostationary orbit so appears to be at fixed point above surface of Earth. Must be at certain/correct height/c.37 000 km above equator. Satellite has transmitting dish pointed at Earth. Satellite has transponder(s) which receive(s) and transmit(s) signals (to/from Earth). Receive and transmit signals use different frequencies. Transmit (to Earth) signals are in set range/4–8 and 12–18 GHz range. Horizontal and vertical signal polarisation is used to increase capacity. Digital TV signal is encoded as standard/MPEG-2 TV signal with sound/audio (uplinked from Earth station). TV signal may be encrypted to prevent viewing without paying for service. High definition/ MPEG-4 TV signals with multi-channel sound requires more bandwidth. Receiving dish on Earth is pointed at the satellite in line of sight. Dish has Low Noise Block/LNB at antenna to amplify signal allows use of cheaper cable to receiver. Receiver/TV/set-top box decodes signal into pictures and sounds for display on TV. May include system for decrypting 'scrambled' pay TV signal.	**8**

March 2020 – P32

7 Describe how peer-to-peer file sharing can be carried out using the BitTorrent protocol.

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Answer:

7	*Six from:* Multiple servers/source computers can be/are used without a central server BitTorrent client required on internet-connected computer to implement BitTorrent protocol Protocol works well/effectively over low-bandwidth connections BitTorrent descriptor file is used to describe file being distributed BitTorrent node set up with use of descriptor file and file to be distributed Node becomes seed for download Files made available to others for download by connection to seed/other peers File being distributed is divided into small segments/pieces Segment/piece becomes available to other peers as it is downloaded …original seed/source is relieved of load Every segment/piece is encrypted/protected by a cryptographic hash that can be used to detect changes to ensure file integrity Segments/pieces downloaded in random order/non-sequentially and re-ordered by BitTorrent client.	**6**

8 Evaluate, by weighing up the advantages and disadvantages, the use of wireless communications in the home.

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Question 8

Answer:

8	*Eight from e.g.:* Enables distribution of internet/network traffic/television and radio signals around home Allows (remote) control of devices/TVs/devices without the need for wired connections Allows use of multiple wireless handsets to use one wired landline so no need for extra lines/connections to landline Allows use of wireless doorbells without damage to infrastructure of building/doors Allows communication without disruption/unsightliness of wires so can be used in historic buildings Allows multiple devices to connect to central points/internet access points so no need for additional internet connections/ISPs Allows easy sharing of devices/printers/scanners between computers so no need for complex configuration/setup routines/installations Allows devices to be moved around/mobility of devices while in use so user can work anywhere Allows use of (discrete) hearing aids connected to e.g. TV sets so no need for embarrassment of user/high sound volumes that disturb others Allows use of remote control/monitoring of household appliances when away from home Allows remote placement of security devices/cameras to avoid tampering/revealing placement position Can be subject to interference from electronic devices/microwave ovens/fridges so can prove unreliable Can create security issues if not set up properly so users' personal information can be at risk. *Must be at least 1 advantage and 1 disadvantage for full marks.* *One mark available for reasoned opinion/conclusion.*	**8**