9.4 TCP IP part 1 Mark Scheme

Q1.

All marks AO1 (understanding)

Level	Description	Mark Range
4	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. The response covers all three areas indicated in the guidance below and in at least two of these areas there is sufficient detail to show that the student has a good level of understanding. To reach the top of this mark range, a good level of understanding must be shown of all three areas.	10-12
3	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response which shows a good level of understanding of at least two areas indicated in the guidance below.	7-9
2	A limited attempt has been made to follow a line of reasoning and the response has a mostly logical structure. At least four points have been made. Either a good level of understanding of one area from the guidance has been shown or a limited understanding of two areas.	4-6
1	A few relevant points have been made but there is no evidence that a line of reasoning has been followed. The points may only relate to one or two of the areas from the guidance or may be made in a superficial way with little substantiation.	1-3

Guidance – Indicative Response

For each guidance point, if the student expands on the point to explain in what way the measure will improve performance then this can be considered to be a second point. For example:

- "Using a processor with more cores" is one point.
- "Using a processor with more cores which will be able to execute multiple instructions simultaneously" is two points.

Note that just "faster" is not enough to count as an expansion point without an explanation of why.

1. Server Hardware

Replace the processor with one which has more cores

Replace the processor with one which has more cache memory // increase the

amount of cache memory

Replace the processor with one which runs at a faster clock speed **NE.** faster processor

Use a parallel processor architecture // use more processors which can work in parallel

Use a processor with a bigger word size

Use a processor that makes (better) use of pipelining

Install more RAM // main memory // primary memory

Use RAM // main memory // primary memory with a faster access time

Replace HDDs with SSDs // Replace HDDS with HDDs that can read data at a faster rate

Defragment the HDD

Replace the motherboard with one which has buses which run at a faster clock speed

Replace the motherboard with one which has more lines in the data bus

Use the Harvard architecture

Distribute the processing across multiple servers

2. Network

Replace the network cable with cable that has a higher bandwidth // replace copper cable with fibre-optic cable **A.** Ethernet cable for fibre-optic NE. higher bandwidth network

Replace any wireless / WiFi connections with wired ones

Replace the network cards with ones that can transmit data at a higher bitrate

Consider the overall network design eg how the network is divided into subnets **A.** split the network into subnets

Use a star topology (instead of a bus)

Consider using a more efficient protocol for the data across the network

Add additional wireless access points

3. Database and Software

Use a more efficient technique for controlling concurrent access to the database // replace record/table locks with serialisation/timestamp ordering/commitment ordering

Replace the database software with software that uses more efficient algorithms for tasks **A.** examples eg replace linear search with binary search

Use the index feature of the database to speed up searching on fields that are commonly used for this purpose

Rewrite the database software in a language that is suitable for concurrent execution // use a functional programming language for the database software

Ensure the software is compiled rather than executed by an interpreter // rewrite the software in assembly language/machine code

Review the conceptual model of the database to see if it contains any inefficiencies such as data redundancy that could be eliminated **A**. normalise the database design

Consider if it would be appropriate to sacrifice normalisation of the conceptual model to improve performance

Use a non-relational database system **A.** examples eg NoSQL

Distribute the data across multiple servers

Try to reduce the amount of other (unrelated) software that might be running on the database server at the same time

Try to reduce the number of database accesses that need to be made simultaneously // run some tasks at quiet times / overnight

Purge / archive data that is no longer necessary / in use

[12]

Q2.

(a) **Mark is for AO1 (understanding)**

1 mark: Correct binary pattern (below):

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0

1

(b) **Mark is for AO2 (apply)**

30 // $(2^5)-2$;
A. 32, 2^5, 31, $(2^5)-1$ (this time only)

1

(c) **1 mark for AO1 (understanding) and 3 marks for AO1 (knowledge)**

Purpose (1 mark – AO1 (knowledge)):
To automate the configuration of hosts connecting to a (TCP/IP) network // to allocate IP addresses / subnet mask / default gateway to hosts;
A. "computer" or suitable alternative term for "host"

Why used (1 mark – AO1 (understanding)):

Reduces the need for expert knowledge when configuring a host // reduces the time required to configure hosts // facilitates efficient use of a limited pool of IP addresses // avoids errors with a relevant example such as duplicating IP addresses or programming incorrect subnet mask;
A. enables reuse of IP addresses
N.E. "avoiding errors" without an example

Contents of communication (Max 2 marks – AO1 (knowledge)):

1. Host sends request to discover a (DHCP) server; **A.** host sends request for configuration
2. (DHCP) server(s) offer configuration to host; **NE**. server gives IP address to host
3. Host accepts offer of configuration from (a DHCP) server (by echoing the accepted configuration back to the server);
4. (DHCP) server confirms that configuration has been allocated to host;

A. "IP Address" for "configuration" but **NE**. "subnet mask", "default gateway" for this mark point
Award one mark for any one correct point OR two marks for any two correct points, made in the correct order.

4

[6]

Q3.

All marks AO1 (understanding)

Traffic arriving on the HTTP(S) port // the port used for web services // port 80/8080/443 (from outside the network) // HTTP(S) traffic (from outside the network);

Must be forwarded (by the External Router) to the IP address of the Web Server // IP address 192.168.16.12;

[2]

Q4.

All marks AO1 (understanding)

1 mark: The 'Router and Firewall' port labelled **A**: 192.168.0.x where x is not 0 or 255;

1 mark: The 'Router 2' port labelled **B**: 192.168.2.x where x is not 0 or 255;

[2]

Q5.

(a) HyperText Transfer Protocol;

1

(b) HTTPS is secure;
HTTPS (usually) uses port 443, HTTP (usually) uses port 80 // use different port numbers;
HTTPS uses SSL/secure socket layers;
HTTPS is encrypted;
Servers using HTTPS must have a public key certificate;

Max 1

[2]

Q6.

Layer involved:
Transport layer;

Client ports: (MAX 1)
client port allocated to web browser (by transport layer);
client port number sent to web server at start of communication (so it can respond to browser);
client ports are temporary;
client ports are allocated by the transport layer to applications running on the client;

Well-known ports: (MAX 1)
web server uses well known port (80/8080) so that client is able to contact it to initiate;
used by applications on servers so that clients can access them due by using a standard port number;
well-known ports are in the range 0 – 1023;

[3]

Q7.

URL	Domain	IP	Socket	Protocol

		name	address	address	
Telnet					✔
192.168.10.23:80				✔	
http://www.bbc.co.uk	✔				

1 mark - one row correct
2 marks - ALL rows correct
A. Marks other than ticks if intention clear

[2]

Q8.

SUBJECT MARKING POINTS:

Internal:

- Student's computer uses subnet mask (and destination/web server's IP address) to determine if destination computer/web server is on same subnet // identify not on same subnet
- Up to two marks from description (in separate section below) of how subnet mask is used
- Packet is sent (from student's computer) to Router (1)
- Router 1 identifies that destination is outside the LAN so forwards packet to router 3/router connected to Internet **A** gateway connected to Internet

External:

- Hierarchical organisation of routers
- Example of hierarchical organisation of routers eg passed up to a national router, transferred internationally and then passed back down a hierarchy
- Path to take selected by each router (not determined at start) **NE**. passed from router to router
- Route may change as a result of eg congestion, technical problems

Either:

- (Possible) repackaging of packet to use different protocol
- Route determined using the (Network ID part of the destination) IP address (**Note:** can infer "IP address" if just "address" is stated, if previously candidate has written about an IP address)
- Use of router tables / criteria to determine next hop / (step of) path
- Router decrementing "time to live" of packet
- Source and destination MAC addresses changed at each router // MAC addresses used for each "hop"

How subnet mask used (MAX 2 points):

- AND operation of subnet mask with student's computer's IP address
- AND operation of subnet mask with web server's IP address
- Result (of AND operation) is the network ID
- Network IDs compared
- If they are the same, then the computers are on the same subnet

A. Interchangeable use of subnet ID and network ID

HOW TO AWARD MARKS:

Mark Bands and Description	
7-8	*To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all 5 of the quality of language criteria (QLx).* *SUB* Candidate has covered both internal and external routing in detail and has made at least seven subject-related points. *QWC1* Text is legible. *QWC2* There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear. *QWC3* The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently. *QWC4* Sentences (and paragraphs) follow on from one another clearly and coherently. *QWC5* Appropriate specialist vocabulary has been used.
5-6	*To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QLx).* *SUB* Candidate has covered both internal and external routing, although one may be in more detail than the other and has made at least five subject-related points. *QWC1* Text is legible. *QWC2* There may be occasional errors of spelling, punctuation and grammar. Meaning is clear. *QWC3* The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently. *QWC4* The candidate has used well-linked sentences (and paragraphs). *QWC5* Appropriate specialist vocabulary has been used.
1-4	*To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QLx).* *SUB* Candidate may not have covered both internal and external routing, but has covered at least one of them. Up to four relevant points have been made. *QWC1* Most of the text is legible. *QWC2* There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response. *QWC3* The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed. *QWC4* Sentences (and paragraphs) may not always be well-connected. *QWC5* Specialist vocabulary has been used inappropriately or not at all.
0	Candidate has made no relevant points.

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of

language criteria then drop mark by one band, providing that at least 4 of the quality of language criteria are met in the lower band. If 4 criteria are not met then drop by two bands.

[8]

Q9.

(a) System will be storing confidential/personal data (that must be kept securely/safely);
Centralised/improved security management // centralised login system // centralised administration // administration will be easier;
Centralised backup;
Harder for users to change security/sharing settings;
Running database from a server will avoid concurrency issues // will avoid problems if two users/computers update (a record in the) database simultaneously; **A**. Will allow simultaneous updates/access **R**. Answers that imply that on a peer-to-peer system there would be a separate copy of the database on each workstation
Running database from server will ensure that it is always available (as server is unlikely to be turned off) // Files would always be available (as server is unlikely to be turned off);
Server (operating system) may allow more simultaneous connections than a workstation // (operating system software on) workstations may not allow enough simultaneous connections for ten users;
NE. The database could be stored on the server

Max 2

(b) **How works (MAX 3):**
All/most processing done by (central) server; **A**. All software run on server
Keystrokes/mouse clicks/user input transmitted from workstation/terminal to server over network; **A**. Workstations are just interfaces
Image/data needed to produce image transmitted from server to terminal over network;
Applications not installed on (thin client) workstations // all applications on server;
Operating system loaded by clients from server at boot;

Selection of hardware (MAX 3):
Higher bandwidth network connection required;
Network must use switch not hub;
Slower processor /reduced RAM/ no HDD required in workstations;
A. Other examples of limited hardware requirements **A**. 'Dumb terminal'
Server must have multiple processors/a lot of RAM;
NE. More powerful / less powerful, higher performance / lower performance, cheaper / more expensive
Accept the opposite of points eg for "Slower processor" accept "a thick client system would need a faster processor".

6

(c) College network uses a different protocol from the Internet/their ISP // College network does not use TCP/IP;
A. Examples of different protocols/hardware types being used

1

[9]

Q10.

(a) A numerical label/value assigned to a device;
A series of four bytes // a 32 bit number;

A. a series of 16 bytes // a 128 bit number;
A. octet as an alternative to byte
R. Internet Protocol

MAX 1

(b) (i) A set of rules (for communication between devices);

1

(ii) **HTTP:**
HTTP is a protocol for accessing websites which are usually available to the general public;

Telnet (MAX 1):
The school does not wish people outside of the school network to remotely login to a school computer // open Telnet port is a security risk;
A. Telnet is an insecure protocol;

2

(c) **Client server model:**
- User runs a client application to connect to the server/server application // client sends a request to the server
- Server (performs processing and) sends result back to client

Steps to update server:
- Run the Telnet client on the laptop to connect to the company server
- Login to the company server
- Run the FTP client on the company server // use of FTP client to connect to FTP server
- Login to the security update FTP server using username and password
- Download/transfer the required file
- Run the command to install the security update // apply the security update
- Log off from the server // Disconnect from the server

Alternative steps:
- Run the FTP client on the laptop to connect to the security update Server using username and password
- Download/transfer the required file
- Connect to the company FTP server
- Upload the required file from the laptop
- Run the Telnet client to connect to the company server
- Login to the remote server
- Run the command to install the security update // apply update
- Log off from the server // Disconnect from the server

HOW TO AWARD MARKS:

Mark Bands and Description

5-6	*To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all 5 of the quality of written communication criteria (QWCx).* *SUB* Candidate has made at least five mark-worthy points and covers both the client server model and the steps form a logical sequence to update the server. *QWC1* Text is legible. *QWC2* There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear. *QWC3* The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently. *QWC4* Sentences (and paragraphs) follow on from one another clearly and coherently. *QWC5* Appropriate specialist vocabulary has been used.
3-4	*To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the quality of written communication criteria (QWCx).* *SUB* Candidate has made at least three mark-worthy points. *QWC1* Text is legible. *QWC2* There may be occasional errors of spelling, punctuation and grammar. Meaning is clear. *QWC3* The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently. *QWC4* The candidate has used well-linked sentences (and paragraphs). *QWC5* Appropriate specialist vocabulary has been used.
1-2	*To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 3 of the 5 quality of written communication criteria (QWCx).* *SUB* Candidate has made a small number of relevant points. *QWC1* Most of the text is legible. *QWC2* There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response. *QWC3* The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed. *QWC4* Sentences (and paragraphs) may not always be well-connected.

	QWC5 Specialist vocabulary has been used inappropriately or not at all.
0	Candidate has made no relevant points.

6

[10]

Q11.

SUBJECT MARKING POINTS:

How systems work:

Rich client:

- Applications run (locally) on computer // all processing done on (local) computer // applications installed locally **A.** On client

Thin client:

- All/most processing done by (central) server // applications not installed on (thin client) workstations // all applications on server; **A.** All software run on server
- Keystrokes/mouse clicks/user input transmitted from workstation/terminal to server over network, **A.** Workstations are just interfaces
- Image/data needed to produce image transmitted from server to terminal over network
- Operating system loaded by clients from server at boot

How hardware differs for thin client:

- Higher bandwidth network connection required
- Network must use switch not hub
- Slower processor /reduced RAM/ no HDD required in workstations, **A.** Other examples of limited hardware requirements, **A.** 'Dumb terminal'
- Server must have multiple processors/a lot of RAM

N.E. more powerful / less powerful, higher performance / lower performance, cheaper / more expensive

Accept the opposite of points e.g. for "a thin client system could use a slower processor" accept "a thick client system would need a faster processor" but don't award marks for a point and its opposite point.

Why SaaS is a type of thin client:

Software is run on a remote computer (not locally, so an example of thin client)
A. Server, web server for "remote computer"
N.E. Accessed via internet

What distinguishes SaaS from other types of thin client:

- SaaS is accessible anywhere that there is an internet

connection // is used via the internet
- Customers usually purchase access to SaaS instead of buying software outright
- SaaS is usually managed by an application service provider / another company / a contractor // company using SaaS does not need to manage software
- SaaS usually works in (web) browser

HOW TO AWARD MARKS:

Mark Bands and Description	
7-8	*To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all 5 of the quality of written communication criteria (QWCx).* *SUB* Candidate has written a detailed explanation of how thin client systems work in comparison to rich client systems, and has also made a good comparison of the hardware required for both types of system. Some points have been made about how SaaS is distinguished from other types of thin client system. The candidate has made at least seven subject-related points. *QWC1* Text is legible. *QWC2* There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear. *QWC3* The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently. *QWC4* Sentences (and paragraphs) follow on from one another clearly and coherently. *QWC5* Appropriate specialist vocabulary has been used.
5-6	*To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of written communication criteria (QWCx).* *SUB* Candidate has made some points in both of the areas of how thin client systems work in comparison to rich client systems, and how the hardware requirements of each type of system vary. The candidate has made at least five subject-related points. *QWC1* Text is legible. *QWC2* There may be occasional errors of spelling, punctuation and grammar. Meaning is clear. *QWC3* The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently. *QWC4* The candidate has used well-linked sentences (and paragraphs). *QWC5* Appropriate specialist vocabulary has been used.

1-4	*To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of written communication criteria (QWCx).* *SUB* Candidate has made some relevant points, but these are superficial or narrow in scope. *QWC1* Most of the text is legible. *QWC2* There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response. *QWC3* The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed. *QWC4* Sentences (and paragraphs) may not always be well-connected. *QWC5* Specialist vocabulary has been used inappropriately or not at all.
0	Candidate has made no relevant points.

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of written communication criteria then drop mark by one band, providing that at least 4 of the quality of language criteria are met in the lower band. If 4 criteria are not met then drop by two bands.

[8]

Q12.

(a) SMTP;

Telnet;
A SSH;

Note
For SMTP accept Simple Mail Transfer Protocol
For SSH accept Secure Shell

2

(b) Uniform Resource Locator;

I case

1

(c) 129.12.3.236 // 10.0.1.1 // 81.111.110.1 // 213.105.114.89 // 62.253.174.77;

I brackets

1

(d) A link between routers might be down / busy and / or a different route is picked;

Routes are determined dynamically as the packet moves from sender to receiver;

A to take the fastest route at that time
NE to travel faster

MAX 1

(e)

	Layer
1	Application (layer)
2	Transport (layer)
3	Network / internet (layer)
4	Link (layer)

1 mark for any two layers correct;
2 marks for all four layers correct;

2

(f) (Link layer) responsible for network drivers // network cabling // physical connection // changing from one medium to another;

(Link layer) (removes MAC address and) adds MAC address for the next hop;
A hardware address for MAC address

(Network layer) looks at destination IP address;

Router decides on next appropriate hop (after seeing destination IP address);

(Network layer) can split / combine / resize packets if required;

error checking / error detection;
encryption for wireless connections;
tunnelling through a firewall;

MAX 2

[9]

Q13.

(a) 192.168.0.x (where x is not 0, 2 or 255);

1

(b) Star (topology);
A Star network
I additional writing that does not talk out the response

1

(c) Devices are not directly connected to the Internet;
NE all computers on a private network

So that LAN devices cannot be connected to (directly) by computers outside of the LAN / on the Internet // for increased security;
A relevant examples of increased security

Don't need to be allocated by a central authority // would be difficult to organise for each device to have a unique (routable) IP address // easier to allocate if do not need to be unique // (as devices not directly connected to Internet) IP addresses don't need to be globally unique;
NE routable IP addresses globally unique and non-routable only locally unique

Would / May not be enough unique IP addresses for each device to have a routable address // globally more IP addresses would be required if all devices had routable IP addresses // more bits would be required to store an IP address if all devices had routable IP addresses;

MAX 2

2

(d) AND operation performed using IP address(es) and subnet mask (to produce network IDs / subnet IDs of both desktop computer and FTP server) // Network IDs / subnet IDs / first three octets / bytes / values (in IP addresses) computed using IP address(es) and subnet mask;

To award either of the next two marks, the candidate must have indicated that the subnet mask is used to produce the results that will be compared - even if the method by which the subnet mask is used is incorrect so the first mark has not been awarded.

Network / subnet IDs of both computers / machines compared;
A Results of previous operation compared
A First three octets / bytes / values (in IP addresses) compared
A Award this mark by implication if it is stated what will happen if these two are the same or different

As network / subnet IDs (**A** first thee octets / bytes / values / results) differ, desktop computer determines that FTP server is not on same network (so must be communicated with via combined device);

3

(e) Block / allow (traffic on) specific ports // block specified protocols;
Block / allow (traffic from) specific IP addresses / domain names;
Search packets for specific contents / text (and block / allow based on this);
Act as a proxy server // all traffic to Internet must go via firewall // stops computers on the Internet directly accessing devices on the LAN;
Stateful inspection // firewall maintains information about current connections and only allows packets relevant to these connections through;
Identifies unusual behaviour from a host // example of unusual behaviour eg sending an unusually large amount of data;
NE Packet filtering
NE "Data" instead of "packets"
NE Block specific programs connecting to Internet
A Firewall checks packets using rules / criteria for 1 mark if not other marks awarded
MAX 3

3

(f) *Baseband*
Whole bandwidth of medium dedicated to one transmission (at a time) // one channel (at a time) // only one computer can send data (at a time) // sends signals with frequencies from 0Hz to a maximum highest frequency;
Broadband
Bandwidth of medium shared // multiple channels can be carried

(simultaneously) // many computers can send data (simultaneously) // frequency bands assigned to different communications; **TO** multiple wires
MAX 1

1

(g) More reliable // less susceptible to interference // more stable connection;
Faster transmission speed // higher bit rate // lower latency;
R More secure (not relevant in this instance)
NE Just the word "faster" on its own.
MAX 1

1

[12]

Q14.

(a) (i) **A** the protocol to be used / / secure hyper-text transfer protocol / / hyper-text transfer protocol secure;
NE hyper-text transfer protocol
B the FQDN / / fully qualified domain name;
A the address of (AQA's) web server
C the path and resource to be returned;
A path / pathname / file path

3

(ii) uk / / .uk ;

1

(b) (i) To take a required FQDN and to return an IP address;
To link / map a FQDN to an IP address;
A domain name for FQDN
R URL

1

(ii) The (local) computer already has a copy of the needed IP address (in a hosts file);
The (local) computer has a cache of recent DNS queries / answered DNS queries;
A previously visited site / refreshing a page;
The URL typed in already contains an IP address;
The URL refers to a local resource, e.g., a file on the local computer / / localhost ;
NE intranet

MAX 2

(c) (i) application (layer);
A fourth layer;

1

(ii) To fetch different parts of the web page that also include an URL;
To fetch a needed image / video / javascript / css / resource;
R transmission error
R network busy

MAX 1

(iii) Port that is temporarily assigned / only exists for duration of a connection;
Port number automatically allocated / / assigned from the TCP / IP stack;
A a port number in range 1024 - 65535

MAX 1

[10]

Q15.

(a) (i) 192.168.0.x where x is not 0 or 255;
Must be a specific IP address
R addresses that include port numbers

1

(ii) 192.168.1.x where x is not 0 or 255;
Must be a specific IP address
R addresses that include port numbers

1

(iii) 192.168.1.y where y is not 0 or 255 and is not the same as x in (ii);
Must be a specific IP address
R addresses that include port numbers

1

(b) Bus (topology / network);
A Line

1

(c) 255.255.255.0 / FFFFFF00 /
11111111 11111111 11111111 00000000;

1

(d) (An operating system that is optimised to) provide (one or more specialised) services to (network) clients;
A description of examples of services e.g. logging on, sharing printers, but just the example of accessing files is not enough as this is in the question. There needs to be additional explanation if files is used as an example, e.g. managing quotas, security of files.
R answers that imply that server does all processing i.e. confusion with thin client

1

(e) (i) Use of Wired Equivalent Privacy / WEP / WPA / WPA2 / WiFi Protected Access;
(Strong) encryption of transmitted data // use of Advanced Encryption Standard / AES; **R**encoding Use of Extensible Authentication Protocol / EAP; User / computer must enter / send a passphrase / certificate at start of communication before laptop allowed to connect; **A** key for passphrase **A** only allow password if used in correct context ie for accessing network, not for logging on to a server or just having a password
Access point checks MAC / hardware address of laptop and only allows computers with a MAC / hardware address in a list of approvedaddresses to connect; **R** IP address
Disable broadcast of SSID / identity;
Reduce / limit power of transmitter;
Use of two / multi-factor authentication;

1

(ii) Longer range // faster transmission speeds // higher bandwidth // more simultaneous connections;
A reverse of points e.g. "Bluetooth only has a short range"
R Bluetooth can only connect two devices at once

1

(f) **SUBJECT MARKING POINT S:**

Internal:
- Student's computer uses subnet mask (and destination / web server's IP address) to determine if destination computer / web server is on same subnet // identify not on same subnet
- Up to two marks from description (in separate section below) of how subnet mask is used
- Packet is sent (from student's computer) to Router (1)
- Router 1 identifies that destination is outside the LAN so forwards packet to Gateway

External:
- Hierarchical organisation of routers
- Example of hierarchical organisation of routers e.g. passed up to a national router, transferred internationally and then passed back down a hierarchy
- Path to take selected by each router (not determined at start) **NE** passed from router to router
- Route may change as a result of e.g. congestion, technical problems

Either:
- (Possible) repackaging of packet to use different protocol (e.g. Gateway may change protocol)
- Route determined using the (Network ID part of the destination) IP address (Note: can infer "IP address" if just "address" is stated, if previously candidate has written about an IP address)
- Use of router tables / criteria to determine next hop / (step of) path
- Router decrementing "time to live" of packet
- Source and destination MAC addresses changed at each router // MAC addresses used for each "hop"

How subnet mask used (Max 2 points):
- AND operation of subnet mask with student's computer's IP address
- AND operation of subnet mask with web server's IP address
- Result (of AND operation) is the network ID;
- Network IDs compared
- If they are the same, then the computers are on the same subnet
  A interchangeable use of subnet ID and network ID

HOW TO AWARD MARKS:

Mark Bands and Description

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all 5 of the quality of language criteria (QLx).

SUB Candidate has covered both internal and external routing in detail and has made at least seven subject-related points.
QWC1 Text is legible.
QWC2 There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
QWC3 The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
QWC4 Sentences (and paragraphs) follow on from one another clearly and coherently.

QWC5 Appropriate specialist vocabulary has been used.

7-8

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality oflanguage criteria (QLx).

SUB Candidate has covered both internal and external routing, although one may be in more detail than the other and has made at least five subject-related points.
QWC1 Text is legible.
QWC2 There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.
QWC3 The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.
QWC4 The candidate has used well-linked sentences (and paragraphs).
QWC5 Appropriate specialist vocabulary has been used.

5-6

To achieve a mark in this band, candidates must meet the subjectcriterion (SUB) and 4 of the 5 quality of language criteria (QLx).

SUB Candidate may not have covered both internal and external routing, but has covered at least one of them. Up to four relevant points have been made.
QWC1 Most of the text is legible.
QWC2 There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.
QWC3 The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.
QWC4 Sentences (and paragraphs) may not always be well-connected.
QWC5 Specialist vocabulary has been used inappropriately or not at all.

1-4

Candidate has made no relevant points.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question. If a candidate meets the subject criterion in a band but does not meet the quality of language criteria then drop mark by one band, providing that at least 4 of the quality of language criteria are met in the lower band. If 4 criteria are not met then drop by two bands.

8

(g) Any two points from the list below. Candidate only needs to make one side of point, the other can be implied. Do not award marks for two sides of same point.

Routable	**Non-Routable**
(Globally) unique	Many computers / devices may have same address
Allocated by a central / regional issuing authority	Not allocated centrally // allocated by a home user / company / ISP

(**A** example)	
Can be connected to directly over the Internet / from outside private network	Difficult / impossible to connect to over Internet // from outside of network
Owner can be looked up using WHOIS protoco	Owner cannot be looked up using WHOIS protocol

A non-routable IP addresses more secure as cannot be connected to over Internet / from outside network
A can identify location from a routable IP address

2

[18]

Q16.

(a) (i) To manage / control / execute commands on a remote machine;
A remote access / login
A a clear example of remote management
NE remote viewing
R remote desktop

1

(ii) Enable files on one host / computer / client to be copied to another host / computer / server;
To manage files on a remote computer / server;
A to upload / download / transfer files
NE "sharing"
NE load a file
NE transfer data

1

(iii) To retrieve / fetch (stored) email;
To check for new emails;
A access / download / receive
R sending
TO any mention of sending
NE just "email"

1

(b) (i) 192.168.3.205 // 74.125.4.148 // 208.43.202.29;

1

(ii) 80 // 25 // 58539 // 57458 // 57459;
I colons

1

(iii) 192.168.3.205:80 //
192.168.3.205:25 //74.125.4.148:58539 //
208.43.202.29:57458 // 208.43.202.29:57459 ;

1

(c) Servers might be in another room / site / cupboard / inaccessible ;

Servers might not have a keyboard / monitor installed ;
Can manage multiple servers from one machine;
Servers can be managed outside of work hours / from anywhere;
It would be quicker (**A** more convenient) (to manage from her machine than visit the servers) // better time management;
Server rooms are often uncomfortable places for people to work in;
NE she does not need to go to the servers

Max 2

[8]

Q17.

(a) System will be storing confidential / personal data (that must be kept securely / safely);
Centralised / improved security management // centralised login system // centralised administration // administration will be easier;
Centralised backup;
Harder for users to change security/sharing settings;
Running database from a server will avoid concurrency issues // will avoid problems if two users / computers update (a record in the) database simultaneously;
A will allow simultaneous updates / access
R answers that imply that on a peer-to-peer system there would be a separate copy of the database on each workstation
Running database from server will ensure that it is always available (as server is unlikely to be turned off) // Files would always be available (as server is unlikely to be turned off);
Server (operating system) may allow more simultaneous connections than a workstation // (operating system software on) workstations may not allow enough simultaneous connections for ten users;
NE the database could be stored on the server

Max 2

(b) **Subject-related points:**

How works:
All / most processing done by (central) server;
A all software run on server
Keystrokes/mouse clicks / user input transmitted from workstation/terminal to server over network;
A workstations are just interfaces
Image / data needed to produce image transmitted from server to terminal over network;
Applications not installed on (thin client) workstations // all applications on server;
Operating system loaded by clients from server at boot;
Selection of hardware:
Higher bandwidth network connection required;
Network must use switch not hub;
Slower processor / reduced RAM / no HDD required in workstations;
A other examples of limited hardware requirements
A 'Dumb terminal'
Server must have multiple processors/a lot of RAM;
NE more powerful / less powerful, higher performance / lower performance, cheaper / more expensive
A the opposite of points e.g. for 'Slower processor' accept 'a thick client system would need a faster processor'.

How to award marks:

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all 5 of the quality of language criteria (QWCx).

SUB	Candidate has covered both how a thin-client system works and how this affects the choice of hardware, and has made at least four subject-related points.
QWC1	Text is legible.
QWC2	There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
QWC3	The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
QWC4	Sentences (and paragraphs) follow on from one another clearly and coherently.
QWC5	Appropriate specialist vocabulary has been used.

4

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

SUB	Candidate has covered both how a thin-client system works and how this affects the choice of hardware, and has made at least three subject-related points.
QWC1	Text is legible.
QWC2	There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.
QWC3	The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.
QWC4	The candidate has used well-linked sentences (and paragraphs).
QWC5	Appropriate specialist vocabulary has been used.

3

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

SUB	Candidate has covered one or both of how thin client systems work and how this affects hardware choice.
QWC1	Most of the text is legible.
QWC2	There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.
QWC3	The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.
QWC4	Sentences (and paragraphs) may not always be well- connected.
QWC5	Specialist vocabulary has been used inappropriately or not at all.

1–2

Candidate has made no relevant points.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of language criteria then drop mark by one band, providing that at least 4 of the quality of language criteria are met in the lower band. If 4 criteria are not met then drop by two bands.

4

(c) To connect networks using different protocols // to convert transmitted data from one protocol to another;

1

[7]

Q18.

(a) To examine the destination of each packet;
To forward packets from one network to another;
To manage congestion;
Choose an appropriate forwarding route;
Route packets according to destination IP address;
Store incoming packets temporarily;
Change link address in packet;
To store/make use of a routing table;
A data instead of packets
R information / signals

Max 2

(b) SMTP;
POP(3);
IMAP(4);
A full names of the protocols above
A ESMTP // SMAP // LMTP // QMTP

Max 1

(c) **Key Points of Subject Criteria**
Concept that data passed up/down between layers;
A by example – just one needed but must be correct
NE just describing the layers in the correct order

Application layer selects appropriate protocol for the communication // protocol mentioned by example (POP / HTTP);
Application layer is to interact with the user via the email client / web browser;

Transport Layer:
Transport layer establishes end to end communication // Transport layer establishes a virtual path // TCP layer establishes connection between client and server;
Destination and source application level client/server identified by port numbers;
TCP layer uses these port numbers to route reassembled requests/responses to correct application layer client/server;
TCP layer splits and reassembles requests/responses into packets/from packets;
Packets are numbered by transport layer;
Transport layer deals with error control (acknowledgements/retransmission);

Network layer adds source and destination IP addresses; Routers use destination IP addresses to route packets to destination // network layer involved with packet routing;

Link layer adds source and destination hardware/Ethernet/Link layer/MAC addresses;
Link layer destination and source addresses change from link to link;
Link layer moves packets between 2 internet hosts;

Link layer deals with physical connection/cabling;
A Link layer includes network card / drivers;

Network layer strips IP address (when receiving) // Link layer strips MAC address (when receiving);
Server uses received source IP address to know where to send response;

Server uses received client port number to know to which instance of application layer client to send response to;
Servers use well-known ports;
Client port numbers come from the dynamic range;
Packets of Email client/server and Web browser/Web server travel independent paths;
Packets of Email client/server and Web browser/Web server share links//intermingled on links;

Combination of IP address and Port = Socket / described;

Note: Accept answers where candidate uses the IP addresses and ports indicated in the figure to match up with statements above

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

SUB	Candidate has made at least 5 valid points covering.
QWC1	Text is legible.
QWC2	There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
QWC3	The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
QWC4	Sentences and paragraphs follow on from one another clearly and coherently.
QWC5	Appropriate specialist vocabulary has been used.

5-6

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QWCx).

SUB	Candidate has made at least 3 valid points.
QWC1	Text is legible.
QWC2	There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.
QWC3	The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.
QWC4	The candidate has used well-linked sentences and paragraphs.
QWC5	Appropriate specialist vocabulary has been used.

3-4

To achieve a mark in this band, candidates must meet the subject criterion (SUB). The quality of language should be typified by the QWCx statements.

SUB	Candidate has provided at least one point from the above.
QWC1	Most of the text is legible.
QWC2	There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response..
QWC3	The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.

QWC4 Sentences and paragraphs may not always be well-connected or bullet points may have been used.

QWC5 Specialist vocabulary has been used inappropriately or not at all.

1-2

Candidate has not made reference to any of the points above.

0

[9]

Q19.

Concept that data passed up/down between layers;
A by example – just one needed but must be correct
NE just describing the layers in the correct order

Application layer selects appropriate protocol for the communication / protocol mentioned by example;
The role of the application layer is to interact with the user via appropriate application software (eg web browser / ftp client) or the users system (eg synchronising files);

Transport layer establishes end to end communication // Transport layer establishes a virtual path;
Transport layer deals with error control (acknowledgements\retransmission) / segmentation / flow control
Communication split into packets by transport layer // re–assembled by receiver;
Packets are numbered by transport layer;
Transport chooses a Port number for client and destination;

Network / IP layer supplies appropriate IP addresses for source and destination (when sending packets);
Network/IP layer involved with packet routing / moving datagrams to the next network node (router);
Combination of IP address and Port = Socket / described;

Link layer receives packets from network layer and adds MAC addresses;
A hardware address for BOD
Link layer moves packets between 2 internet hosts;
Link layer adds frame header and footer to packets;
Link layer deals with physical connection/cabling;
A Link layer includes network card / drivers;

Network / IP layer strips IP addresses (if receiving packets) // Link layer strips MAC address (if receiving);

Idea of encapsulation described re datagram;

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all of the quality of language criteria (QLx).

SUB Candidate has provided a clear explanation of principles of operation, including at least 6 of the points listed above and **at least 3** distinct levels of the TCP/IP stack.

QL1 Text is legible.

QL2 There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.

QL3 The candidate has selected and used a form and style of writing appropriate

to the purpose and has expressed ideas clearly and fluently.

QL4 Sentences and paragraphs follow on from one another clearly and coherently.

QL5 Appropriate specialist vocabulary has been used.

6–8

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QLx).

SUB Candidate has provided a limited explanation of principles of operation, including at least 3 of the points listed above and **at least two** distinct levels of the TCP/IP stack.

QL1 Text is legible.

QL2 There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.

QL3 The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.

QL4 The candidate has used well-linked sentences and paragraphs.

QL5 Appropriate specialist vocabulary has been used.

3–5

To achieve a mark in this band, candidates must meet the subject criterion (SUB). The quality of language should be typified by the QLx statements.

SUB Candidate has provided a weak explanation which covers at least 1 of the points listed above for 1 mark or 2 points to get 2 marks and **at least one** distinct level of the TCP/IP stack.

QL1 Most of the text is legible.

QL2 There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.

QL3 The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.

QL4 Sentences and paragraphs may not always be well-connected or bullet points may have been used.

QL5 Specialist vocabulary has been used inappropriately or not at all.

1–2

Candidate has not made reference to any of the points listed above.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of language criteria then criteria then drop mark by one band, providing that at least 3 of the quality of language criteria are met in the lower band. If 3 criteria are not met then drop by two bands.

[8]

Q20.

(a) (i) 192.168.0.x where x is not 0 or 255;

1

(ii) 192.168.2.x where x is not 0 or 255;

1

(b) 255.255.255.0;

1

(c) **Reason:** To reduce (network) congestion//improve throughput//to cut the number of collisions*;
A faster operation/transmission;
Explanation: by cutting the number of collisions*//by reducing the number of stations/computers connected to each section of cabling// because two computers in one segment can communicate at the same time as two computers in another segment;
*Note: * = Do not award two marks for cutting the number of collisions – only award one for either reason or explanation.*

Reason: To improve security;
Explanation: by localising packet transmission to one segment;

Reason: To improve reliability;
Explanation: By limiting effect of cable failure to one segment;

Award marks for either:
- *one reason + explanation*
- *two reasons*
- *two explanations*

Max 2

(d) (i) Less expensive as reduced cabling requirement;
No reliance on central node as data does not all travel through one node;
A less cabling required without reference to reduced cost if candidate has explained why less cables are needed
A computer/station for node

Must have explanation as well as advantage for mark

Max 1

(ii) Improved security as: data only travels down one link // is not sent throughout network // is not sent to all nodes;
Improved reliability as if one link fails the other links/nodes are not affected;
Speed of link remains constant // speed not affected by number of connections/collisions // faster connection as: no collisions/links not shared;
A cable for link
R responses about terminal/computer failure

Must have explanation as well as advantage for mark

Max 1

(e) Below are some example security threats and measures, but they are only examples. Award marks for all reasonable security threats and appropriate measures.

Threats:

Virus	Malicious self-replicating programs which attach to other programs
Spam	Unsolicited junk email

Worm	Malicious self-replicating programs which replicate across networks using security vulnerabilities
Remote Login	Ability to login to a computer via Internet **A** "hacking" if explained
Trojan	A malicious program hidden inside another program // masquerading as another program
Phishing	Attempts to get users to divulge personal information
Pharming	Misdirecting users to a fake website by changing DNS entries
Spyware	Program that collects information from a user's computer without user knowing
Denial of Service Attack	Repeated requests/pings from the Internet could overwhelm (parts of) the network.

Threats must be described not simply named.

Measures:

Use a secure operating system
Regularly install security patches/upgrades for software
Use virus checking software + some explanation of what this will do
Keep virus definitions up to date
Use anti-spyware software + some explanation of what this will do
Use of firewall to control traffic between private network and Internet // explanation of how firewall might work
Use of spam filter in email package
Enable web browser features to detect Pharming
Restrictions on which websites users can visit
White lists/black lists
Enforce strong passwords
Encryption of data during transmission
Authentication of user/computer attempting remote login using digital certificate//smart card//security code generating device
Log files
Network manager keeps informed about latest threats // network manager trains users about threats

Measures must be appropriate to security issues described.
More than one measure can be used for the same threat.

How to award marks:

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and all 5 of the quality of language criteria (QLx).

SUB Candidate has described 2 security threats and 3 appropriate measures OR 3 security threats and 2 appropriate measures. To get 6 marks answer must include 3 threats and appropriate measures.

QL1 Text is legible
QL2 There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
QL3 The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
QL4 Sentences and paragraphs follow on from one another clearly and coherently.
QL5 Appropriate specialist vocabulary has been used.

5–6

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of language criteria (QLx).

SUB Candidate has described at least 2 security threats and described 1 or more appropriate security measures OR candidate has named (but not described) some security threats and has described 3 or more security measures
QL1 Text is legible
QL2 There may be occasional errors of spelling, punctuation and grammar. Meaning is clear.
QL3 The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.
QL4 The candidate has used well-linked sentences and paragraphs.
QL5 Appropriate specialist vocabulary has been used.

3–4

To achieve a mark in this band, candidates must meet the subject criterion (SUB). The quality of language should be typified by the QLx statements.

SUB Candidate has described at least 1 security threat and may or may not have described some appropriate security measures OR candidate has named at least one security threat and has described 1 or 2 security measures.
QL1 Most of the text is legible.
QL2 There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.
QL3 The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.
QL4 Sentences and paragraphs may not always be well-connected or bullet points may have been used.
QL5 Specialist vocabulary has been used inappropriately or not at all.

1–2

Candidate has made no relevant points.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question

If a candidate meets the subject criterion in a band but does not meet the quality of language criteria then drop mark by one band, providing that at least 3 of the quality of language criteria are met in the lower band. If 3 criteria are not met then drop by two bands.

6

[13]

Q21.

(a) Provides reliability of transmission // check transmission successful;
Error detection and correction // error handling
A either detection or correction;

Acknowledgement of received packets;
Retransmission of packets if necessary;
Flow control / congestion avoidance / congestion management;
Packet sequencing;
Adding TCP headers;
Pass data to correct process in application layer;
Allocates port numbers;
Dividing data into packets / reassembles data from packets; **NE** "chunks", transports packets
Connection establishment / maintenance;
Creation of virtual circuits // creating an end-to-end connection;

Max 2

(b) HTTP/ HTTPS/ SMTP/ POP3/ Telnet / SSH;
The above are only the most common examples.
Students may provide alternatives and these should be checked.

1

(c) Network (layer);
A IP (layer)

1

[4]

Q22.

(a) (aqa.org.uk) domain name;
R FQDN (courses / computing.html) path name / / location of file / resource / object / document / / path of file / resource / object / document;
NE file name

2

(b) A set of (agreed) rules / codes / signals (for data exchange between systems);
Agreed standard for communication between computer systems;

Max 1

(c) Both use the same protocol;
Both are client-server based;
Both have a similar purpose / / both used to share information / data / resources; **A** access
Both use TCP / IP;
Both are accessed through the use of a URL;
Concept that web pages can be accessed through a web browser on either system / / use of same software;

Max 2

(d) Easier to remember a FQDN or converse for IP address i.e.
IP addresses are less memorable;
FQDN can identify (to a human) what a site is whereas an IP address cannot // easier to understand;

Max 1

[6]

Q23.

(a) (i) Hypertext Transfer Protocol;
A Hypertext as two words

1

(ii) HTTPS is secure;
HTTPS (usually) uses port 443, HTTP (usually) uses port 80/Use different port numbers;
HTTPS uses SSL/Secure Socket Layers;
HTTPS is encrypted;
R encoded
Servers using HTTPS must have a public key certificate;
HTTPS allows authentication of client/users/machines//allows access to be restricted to certain clients/users/machines;
A Reverse of answers e.g. HTTP is not secure etc.

Max 1

(iii) A description of any website which could reasonably require secure data transmission;
R URLs of specific websites
R Social networking sites
R Bank website **NE**
R online shopping without concept of transaction **NE**

1

(b) Port that is temporarily assigned/only exists for duration of a connection;
Port number automatically allocated // assigned from the client's TCP/IP stack;
A Port number 1024 – 4095

Max 1

(c) Communication initiated by clients;
Clients must know which port number to connect to //
(Server) port number must be known by client (before communication with server starts) // So client can select service;
Particular port numbers are used to provide a particular service
// **A** Example of specific well known port number with its use;

Max 2

[5]

Q24.

(a) (i) 192.168.0.x where x is not 0 or 255;

1

(ii) 192.168.2.x where x is not 0 or 255

1

(iii) 192.168.2.y where y is not 0 or 255 and the IP address is different to the one in (ii)

1

(b) Star;

1

(c) Identify which other computers are on same segment // can have packets/data sent directly to them;
Identify which other computers are on a different segment // must have packets/data sent to them via the router;
R network for subnet

Max 1

255.255.255.0 / FFFFFF00 / 11111111111111111111111100000000;

2

(d) Use of WEP/Wired Equivalent Privacy/WPA/WiFi Protected Access;
(Strong) encryption of transmitted data;
R encoding
User/computer must enter/send a passphrase/certificate at start of communication before laptop allowed to connect;
A key for passphrase
A only allow password if used in correct context;
Access point checks MAC/hardware address of laptop and only allows computers with a MAC/hardware address in a list of approved addresses to connect;
R IP address
Disable broadcast of SSID/identity;
Reduce / limit power of transmitter;

Max 2

(e) **Subject-related points:**
(Applies to) bus (topology);
Computer monitors/listens to (data signal on cable/bus);
If (data) signal present // if cable/bus busy continue to wait;
When no (data) signal present // when cable/bus idle start to transmit;
Whilst transmitting, computer monitors cable/bus to check for collision // to check if signal is identical to what it is sending;
Collision occurs if two computers (start) sending at same time // if two packets/frames in transit at same time;
If collision detected, jamming signal/signal warning of collision sent;
To ensure other (transmitting) computers aware of problem // to stop other computers sending data;
Computer that detected collision also stops sending data;
Then waits a random period before attempting to retransmit/repeating transmission/this process;
Period is random to reduce likelihood of collision recurring (between computers that caused collision);
If a collision occurs again then waits a longer random time before attempting to transmit again;
Use of exponential back-off algorithm to determine wait time;

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of written communication criteria (QWCx).

SUB	Candidate has produced a detailed description of how CSMA/CD works, including what happens if there is a collision (at least 5 points).
QWC1	Text is legible.
QWC2	There are few, if any, errors of spelling, punctuation and grammar. Meaning is clear.
QWC3	The candidate has selected and used a form and style of writing appropriate to the purpose and has expressed ideas clearly and fluently.
QWC4	Sentences and paragraphs follow on from one another clearly and coherently.
QWC5	Appropriate specialist vocabulary has been used.

5–6

To achieve a mark in this band, candidates must meet the subject criterion (SUB) and 4 of the 5 quality of written communication criteria (QWCx).

SUB	Candidate has produced a reasonable description which may or may not cover what happens in the event of a collision (at least 3 points).
QWC1	Text is legible.
QWC2	There may be occasional errors of spelling, punctuation and grammar.

Meaning is clear.

QWC3 The candidate has, in the main, used a form and style of writing appropriate to the purpose, with occasional lapses. The candidate has expressed ideas clearly and reasonably fluently.

QWC4 The candidate has used well-linked sentences and paragraphs.

QWC5 Appropriate specialist vocabulary has been used.

3–4

To achieve a mark in this band, candidates must meet the subject criterion (SUB). The quality of written communication should be typified by the QWCx statements.

SUB Candidate has produced a very limited or unclear description of how CSMA/CD works.

QWC1 Most of the text is legible.

QWC2 There may be some errors of spelling, punctuation and grammar but it should still be possible to understand most of the response.

QWC3 The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed.

QWC4 Sentences and paragraphs may not always be well-connected or bullet points may have been used.

QWC5 Specialist vocabulary has been used inappropriately or not at all.

1–2

Candidate has made no relevant points.

0

Note: Even if English is perfect, candidates can only get marks for the points made at the top of the mark scheme for this question.

If a candidate meets the subject criterion in a band but does not meet the quality of written communication criteria then drop mark by one band, providing that at least 3 of the quality of written communication criteria are met in the lower band. If 3 criteria are not met then drop by two bands.

6

[14]

Q25.

(a) Set of rules/agreed signals/agreed codes (for data exchange between systems)
R instructions

1

(b)

	Operation	**Application Layer Protocol**
(i)	Managing a server remotely	Telnet/SSH/SSH2/RSH **A** HTTP/HTTPS if not used in (iii) or (iv)
(ii)	Retrieving e-mail from an e-mail server	POP/IMAP/POP*n*/IMAP*n* where *n* is a number from 1–4 **A** P/IMAP/Push IMAP **A** Telnet if not used in (i) **R** SMTP.

(iii)	Viewing a sports news web page using a web browser	HTTP
(iv)	Accessing your online bank account using a web browser	HTTPS **R** SHTTP

A full names of protocols

Do not allow same answer more than once

4

[5]

Q26.

(a) **Similarity**:
Use same protocols
A example eg. TCP/IP HTTP;
Similar facilities available
A example e.g. email, web site;
Use of same software to access information
A example e.g. web browser.
Similar purpose – sharing information, improved communication;
Both client/server systems;
NE Both use protocols
NE Both are networks

1

Difference:
Internet publicly available vs intranet only accessible within company/by employees / private;
Internet use of public telecommunications network vs intranet may use private network;
Intranet more secure than the Internet;
R Need password for intranet
R Global vs Local

Must state both sides of difference
Must be clear that difference is stated the correct way round

1

(b) (i) Set of rules / agreed codes;
Agreed standard for communication between computer systems;

1

(ii)

Layer	**Function**
Application	Gives applications access to the network; **A** Examples of applications
Transport/TCP	Provides reliability of transmission / check transmission successful; Error detection and correction / error handling **A** either detection or correction Acknowledgement of received packets; Retransmission of packets if required;

	Flow control / Congestion avoidance / congestion management; Packet sequencing; Adding TCP headers; Pass data to correct process in application layer; Allocation of port numbers; Divided data into packets / reassembling data from packets; Connection establishment / maintenance; Creation of virtual circuits;
Network/Internet/IP	Routing; Adds addressing info; Adds source and destination IP addresses;
Link/ Data Link/ Physical	Physical interface with medium/cable; Mapping of IP to MAC addresses; **A** Hardware address Conversion of IP datagrams to network frames; Adds Ethernet / MAC addresses; Adds header / trailer;

1 mark for each correct layer name
1 mark for each correct function associated with the correct layer

4

[7]

Q27.

(a) (i) IP address / Internet Protocol Address;

1

(ii) Uniform Resource Locator;
A Universal Resource Locator

1

(b)
- Forwards / backwards / Navigation – move to a previously viewed page;
- Favourites/Bookmarks – setting up/organising/stores regularly visited sites;
- Options/Tools/Settings – setting up of the Home page / enable/disable features e.g. run JavaScript;
- Home – move to the Home page;
- Refresh – refresh the current page;
- Stop – stop loading the current page / download;
- History – show a list of the last (say) 20 pages displayed;
- Security – change settings / e.g. enable/disable graphics/pop-ups/other content/plug-ins;
- View HTML – source (code);
- Address bar – allows the entering of a URL/IP/web address;
- Search bar – search list for specific web site;
- RSS feeds – receiving content news/updates;
- Application launcher icon e.g. to run email client application;

R HTML editor

Feature followed by NO description scores 0

Good description with feature implied scores 1

Max 2

(c) (i) footyhosting.co.uk

1

(ii) (Each hosted club has) a (sub) folder/directory containing the files for their site;

1

(d) 128 kbps // 2Mbps // 128 kbps AND 2Mbps;
R answers where in addition any other answer is circled

1

(e) (i) (magnetic/server) hard disk/ hard drive;
R removable hard disk
A 'disk' spelt as 'disc'

1

(ii) 8000 GB;

1

[9]

Q28.

(a) If computer wants to send message/packet to an IP address not on same subnet/network // if computer wants to access the internet;
T.O. if implied that all messages are sent to the gateway sends the message/packet to the gateway; which has the IP address subnet.1;

Answer must imply communication not just connection or access

2

(b) Domain name is intercepted by a domain name server;
Domain name server looks up domain name in its database/table/list;
Finds matching IP address;
If it can't find domain name, contacts another Domain Name Server;

The answer must imply the idea of a look up not somehow a conversion which might be a calculation

Max 2

[4]

Q29.

(a) A set of rules/procedures;

1

(b) (i) Transport (Layer);

1

(ii) Network (Layer);

1

(iii) Telnet;
Http (client) // web server // IRC Client Server;
Email;
Internet/web browser;
FTP;

snmp;
TFTP;
A instant messaging / VoIP;
SMTP;
Https;

1

(c) **A** (unique) address / identifier assigned to network card
// (unique) hardware address/identifier
A code
R name instead of address

1

(d) (i) Any IP address in the range 192.168.4.1 to 192.168.4.254
A 192.168.4.255 or 192.168.4.0

1

(ii) 254
A 256, 255, 253

1

(iii) Change the subnet mask // get another network ID // get class A or B Network ID;
Split the network into subnets; **R** segments

Max 1

(iv) For security reasons; not accessible/addressable from outside the LAN;
Avoids massive use of public addresses;

Max 1

(e) Use a router // use a gateway address;
Assign registered IP address (222.125.105.15) to the Internet-facing NIC of Router/gateway;
Assign local IP address (192.168.4.1) to LAN-facing NIC of router;
Local computer sends message to (LAN-facing NIC of) router/gateway;
Router/gateway sends message to Internet using registered IP address (222.125.105.15);
Router/gateway sends reply from Internet to local computer's private IP address;

Max 2

[11]

Q30.

(a) Allows for the sharing of peripherals/hardware; **R** 'Resources' programmers can access their work from any terminal; better communications / internal e-mail/instant messaging; easier/quicker/instant sharing of a program library/ sharing program code/ data files; central storage of documents e.g. program specifications; changes to important documents are held centrally / document management; setting up of an Intranet (for document management); easier for the backup of data;
R anything about program updates

Max 2

(b) (i) Easier/quicker installation/maintenance of the application software / easier backup (only if not in(a));
R Saves space on the PCs / 'Security' / cheaper (licensing)

1

(ii) If server goes down software (may) still be available;
Software will load/accessed faster from secondary store;
Software can be personalised for individual user;
Helps to avoid degradation in network performance;
R anything about the software runs faster

1

(c) (i) Protocol set of rules (about the way devices communicate);
A standards
R Instructions

1

(ii) Handshaking …
Sending signals between devices + implication of 2-way;
Confirmation of ready for sending / receiving data;
Acknowledge that a transfer is completed;

Max 2

(d) smk-solutions.co.uk;
R www.smk-solutions.co.uk

1

[8]

Q31.

(a) Server provides a resource/the Internet/a database/file/application/CD ROM/printer;
Within a network;
Client computer requests the service;
and waits for the response;
I any reference to the user

Max 3

3

(b) (i) Software request causes an event;
A external change causes an event
The event causes a program/ procedure/ function to execute;
I References to user

2

(ii) Mouse Click// mouse movement// key pressed// record read/ written//any external/internal device requires attention;

1

[6]

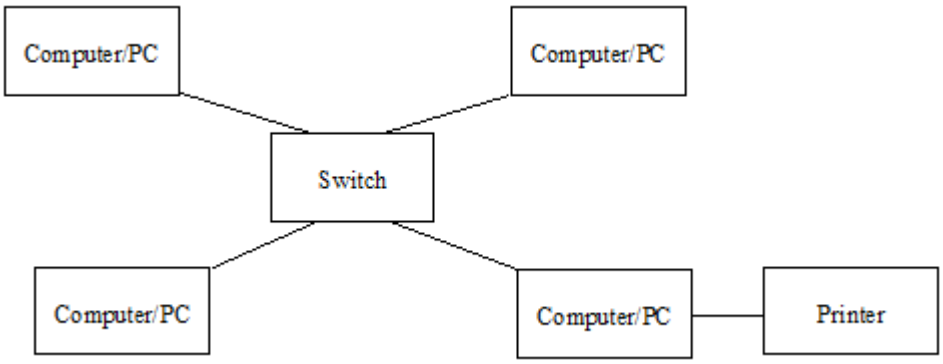
Q32.

(a) In a peer-to-peer network there are no dedicated servers;
In a peer-to-peer network all computers are equal / have equal status;
Each computer functions as both a client and a server;
User at each computer acts both as user and administrator;
User at each computer controls what is shared with other computers;
A user logged in at one peer computer is able to use resources on any other peer computer;
R each computer directly connected to each other, so can send to each other

without a server
R all computers have same rights

Max 1

(b)



T.O. if a server included in driagram
I boxes
I routers / modems
1 mark for switch with 4 computers/PCs connected;
1 mark for printer connected to computer;

2

(c) (i) Computer C is in a different subnet // network ID is different;
A correct IP address
A there are two subnets
R not on the same LAN

1

(ii) 192.168.5; **A** 192.168.5.0;

1

(iii) 0-255; more correctly: 1-254;
or any in the range 192.168.5.1 - 192.168.5.254

(since 0 means all addresses on subnet, and 255 is reserved as roadcast address)
R a specific IP address

1

(d) (i) A router is a device that receives datagrams/packets from one omputer and uses the IP addresses that they contain to pass on these packets, correctly formatted, to another computer; a router is a device that uses IP addresses to route packets/datagrams;
Router keeps LAN traffic segregated from connection to ISP;

1

(ii) IP address: 222.125.105.15
Reason: router needs to have a presence on Internet so that it can be reached from anywhere;
Public address must be unique over whole Internet // must be visible on Internet // provides identity on Internet;
A because 192.168.5.1 is a private/non-routable address;

2

(iii) 192.168.5.1

1

[10]

Q33.

(a) WAN

1

(b) Software cannot be copied;
Customer does not have to keep track of/worry about illegal copies of product on its computers;
The elimination of staff and systems to distribute products;
Help-desk support is simplified when all customers are using the same centrally managed, shared software;
Smaller software development team because different flavours of a product do not have to be developed for customers with different machines, OSs;
Cheaper implementation of improvements, as new software versions only have to be placed on central server;
Faster implementation of improvements, as new software versions only have to be placed on central server //Updates available immediately//Instant delivery – no postal delay;
The elimination of customisation, which means that system integration becomes simpler;
A more efficient feedback loop for getting users' views of suggested enhancements;

Reduces customers' hardware costs;
Reduces customers' storage/hard disk space requirements;
Reduces customers' maintenance support (handling updates//configuring software) requirements;
Access from any computer connected to Internet/network;
A Software cheaper because
R Don't have to pay for updates;

3

[4]

Q34.

(a) **A** set of rules/procedures;

1

(b) Bus;
R Ethernet on its own

1

(c) Twisted pair//coaxial (cable)//optical fibre//fibre optic;

1

(d) Need first octet or first and second octet or first, second and third octet to be identical. Also must have four octets.

For example:
192.168.0.1
192.168.0.2
R without full stops

1 mark for four octets;
1 mark for same LAN;

2

(e) (Use candidate's example from (d))

(i) 192.168.0;

1

(ii) 1 or 2;

1

(f) A (unique) address/identifier assigned to network card // (unique) hardware address/identifier;

1

(g) Any two tasks @ one each
Allocation of port numbers;
Routing a packet/frame/segment to correct application/service;
Splitting messages/data into packets // Disassembling messages // Assembling packets;
Adding TCP headers // Adding sequence nos;
Error handling // sets parity bits;
Checking that transmission successful;
Resending transmission if necessary;
A Sets packet size;

2

(h) Any one of the following applications for one mark;
Telnet;
Internet browser;
http (client) // web server;
email;
FTP;
TFTP;
SMTP;
R Non-networked applications such as word processor

1

(i) Internet Registry // Internet Registrar;
A I.P. Registry/Registrar

1

1

[12]

Q35.

(a) (i) A common attribute(field);
links two /related tables;
// primary and foreign keys;
Create a link;

1 mark per point to max

1

(ii) Property / characteristic of an entity;
One piece of information about an entity / item;

1

(b) (i) To check that data is reasonable/ appropriate;
To check that the data entered meets requirements;
To reduce the chance of incorrect data being entered;

1

(ii) Presence check / required field check;
Uniqueness check;

List membership / lookup list;
Range check;
Format check / picture check;
(data)Type check;
Existence (of data item or record) check;
Field length check / length check;
No of fields check;
R Check digit, Verification;

Also accept a reasonable example;
Any one of the above

1

[5]

Q1.

A very good range of responses was received to this question, with approximately half of students achieving five or more marks. Most students addressed all three aspects of the question (hardware, network, database and software). Students tended to make more points about how the hardware could be improved than about the other two areas. This was acceptable but students needed to have covered all three areas to achieve a mark of ten or above.

Some students wrote too vaguely to achieve marks, for example by writing that a “faster processor” would improve performance, without referencing a factor such as the clock speed that would make the processor faster. Other mistakes included believing that the question required students to contrast thin-client and thick-client and that the system was web based.

A small number of students wrote about issues which might be causing the system to perform poorly instead of explaining how the performance of the system could be improved. Such responses were not worthy of a mark.

Q2.

(a) For this question part students had to express a subnet mask in binary, with 5 bits allocated to the Host ID. Only a quarter of students were able to do this successfully. Common errors were to write the IP address of the external router instead of the subnet mask or to write the subnet mask out backwards.

(b) For this question part students had to calculate how many devices could be connected to the subnet with 5 bits allocated to the Host ID. The correct answer was 30 devices as two of the possible 32-bit patterns that could be represented with 5 bits are reserved. On this occasion any answer in the range 30 to 32 was accepted as this showed some understanding, but students should note that in the future only the precise answer will be accepted for this type of question.

(c) Approximately half of the students were able to provide some explanation of the DHCP system. The most common incorrect responses related to DHCP being a security system that controlled access to a network.

Most students who tackled the question successfully recognised that the purpose of the DHCP system was to allocate IP addresses to devices; fewer explained that other attributes such as the subnet mask were also allocated. The most commonly given reason for why this was useful was because there was a limited pool of IP addresses and this system allowed for them to be reused when they were no longer required.

The contents of the communication between and a device and a DHCP server were less well known, with just over 10% of students achieving more than two of the four available marks.

Students who wrote about the communication often did not appreciate that the request for a configuration was not made directly to a specific DHCP server but was broadcast or that the server returned an offer of a request, rather than simply allocating the configuration immediately that the request was received.

Q3.

The use of port forwarding to provide access to a web server within a network from outside it was not well understood. Only around a fifth of students achieved a mark on this question part. Some students provided generic descriptions of network address translation or wrote too vaguely, not referencing key terms like port and IP address in their responses. Good responses identified that traffic arriving at the web services port of the external router would be forwarded to the web server using its IP address.

Q4.

More students were correctly able to identify a correct IP address for port A and port B. The most common error for part A was to give an IP address which started with the octets 187.17.10 which were the octets on the other port of the same router. Students need to be aware that IP addresses cannot have a value of all zeros or all ones (binary format) in the host ID part. Having all bits as zero or all bits as one in the host ID of an IP address is not allowed as these values have special purposes.

Q10.

Students appear to be developing further their understanding of networking. It was pleasing to see well written responses for part (b) where students could clearly describe why HTTP requests need to be accepted by a firewall and Telnet request denied. Linking HTTP to a need to be able to browse websites was a commonly seen answer. Those students who linked HTTP to being able to browse the Internet did not secure the mark. Telnet appears to be a less known protocol to students but answers discussing the potential problems of allowing remote control of computers inside the school were seen.

Part (c) was answered well and the majority of students secured 3 or more marks. Strong answers clearly described the client-server model and then explained the process of applying the security patch to the company server. A group of students went off in a slightly wrong direction by talking about downloading the security update from a website rather than a FTP server. A few students, who perhaps did not fully understand the question, responded by just talking about the TCP/IP layers and what they are used for. Students who secured high marks could clearly describe the use of an FTP client to connect to the FTP server to allow the update to be downloaded. They then appreciated the need to Telnet across to the company server, login and then apply the update. It was possible to secure full marks for the question by either downloading the update to David's laptop and then uploading to the company server or by remotely connecting to the company server and then downloading the update directly to that server.

Q11.

This question was about methods of using software, including rich (thick) and thin client systems and the use of Software as a Service.

Most candidates achieved some marks and were able to describe the fundamental difference between the two, ie that rich client systems did processing locally whilst thin client systems relied on processing data on a server. Descriptions of the different hardware requirements of the two were less good. As was the case when a similar question was asked previously, many candidates just referred to “better hardware”, “more powerful machines” or even “more hardware”, none of which were markworthy. To achieve marks candidates needed to make specific points such as a rich client needing to have sufficient secondary storage for all the software. Many responses also only concentrated on the hardware requirements of the workstations, ignoring the server and network which would have been required for a thin client system.

With regard to Software as a Service, most candidates knew what this was, ie software that was accessed and run on a remote server, and many candidates wrote a little about it, but few went on to describe many other features of it, such as the fact that it might be provided on a subscription basis rather than as a one-off purchase or that the server would be operated by a separate company who would take care of tasks such as updating the software.

A small number of candidates got rich and thin client systems the wrong way around or compared peer-to-peer with server based systems instead of answering the question asked. Another occasionally seen mistake was to believe that thin clients connected to rich clients so the rich clients could do the processing.

Q12.

The first part of this question looked at identifying protocols in a different way and it was pleasing to see that students could identify a protocol from a screenshot of it being used. Most students spotted that the first one was linked to email and answered with either POP3, SMTP or just email. As the information provided gave details of an email being prepared and sent the actual protocol was SMTP.

The second screenshot proved to be a little bit harder but it was still pleasing to see that a group of students spotted it as either Telnet or SSH. The answer of 'remote login' was not awarded a mark but did show some understanding.

Part (b) proved harder than expected with less than half of students securing the mark. The acronym URL was probably known by the majority of students but it was clear that not many could actually provide the answer uniform resource locator.

It was pleasing to see that students could provide reasons for why traceroute might show different hops. Good answers included the idea that links might be busy or down for some reasons or considered the actual role of the router in deciding which route to send individual packets. The idea that 'a different route was taken' was deemed as not enough in trying to explain why.

Part (f) allowed students to explain the role of the router and those that read the question carefully tended to answer well. It was also clear that some students just quoted the roles of each layer without thinking in terms of an actual router.

Q13.

This question was about networking.

For part (a) students had to identify an appropriate IP address. This was satisfactorily tackled with just under two thirds of students achieving the mark. Common mistakes were to give an IP address that started with the same three octets as the IP address assigned to Port Y of the router instead of Port X, to use 0 as the last octet and to give a three-octet IP address.

Over three quarters of students correctly identified the physical topology as being a star in part (b).

The most frequently seen correct response to part (c) related to the increased security offered by the use of non-routable IP addresses. Other good responses related to the limited number of routable IP addresses available using IPv4, and the difficulty of allocating these to devices. Over half of students achieved one mark, but few went on to achieve both the available marks.

For part (d) students had to explain how the subnet mask was used. Explanations were poor and only a quarter of students achieved any marks at all. Good responses explained that the subnet mask was logically ANDed with the destination IP address to produce the subnet ID of the destination. The same process was repeated with the source IP address and subnet mask to produce the subnet ID of the source. These two subnet IDs were then compared and if they were different (as was the case in the example) then the data would have to be sent to the router instead of directly to the destination. Common misconceptions were that the data was passed around the network until it found a computer where it matched the subnet ID, that the subnet mask was capable of doing things itself, and that the mask was a form of security.

For part (e) students had to describe how a firewall worked. Many responses were superficial, referring only to the data being checked, without explaining against what criteria; just over half of students achieved at least one mark, but very few achieved more than this. Appropriate methods that might be used included using an IP address blacklist, blocking specific ports, inspecting the contents of packets and stateful inspection. Some students erroneously believed that a firewall could perform essentially the same function as virus checking software.

Part (f) was about the difference between baseband and broadband. Just under half of students achieved this mark, and the most common mark worthy response explained that baseband carried one channel over the whole bandwidth of a medium whereas broadband divided the bandwidth up into a number of channels. There was some confusion with parallel and serial transmission and a small number of students, though fewer than when this topic was previously asked about, responded that broadband was faster.

Part (g) was well answered with three quarters of students achieving a mark. The most commonly cited reason was the faster speed of transmission when using a cable or increased reliability, both of which were relevant to streaming television pictures.

Q14.

(a) This part was based around a given URL and asked candidates to identify parts of this URL and then to state the top-level domain. Questions have been asked previously about breaking down a URL into parts and candidates generally made a good attempt at answering this. It should be noted that the question asked candidates to 'describe' and this would generally mean that an answer should be formed into a sentence rather than just one or two words. The protocol section is understood by a lot of candidates but the FQDN (fully qualified domain name) does seem to cause problems. The distinction between a domain name and a fully qualified domain name does appear to be an area of weakness at the moment.

(b) This part asked questions around the Domain Name System (DNS) and it is clear that a certain group of candidates have a good understanding of what DNS is and how it works whilst others have no awareness of this topic. This is an area that would hopefully be taught with students actually performing name lookup queries and considering how domains are registered and settings propagated around the Internet. Candidates with an awareness of this topic could explain that the DNS server would respond to a domain name query with the IP address currently allocated to that domain name. They could then also identify a situation when a DNS query would not need to be sent. It was pleasing to see an understanding of DNS results being cached on a local computer and even seeing some candidates talking about a hosts file. It was also common to see answers such as moving to another page on the website or another page / resource on the same domain. A few candidates seem to think that the DNS server holds the actual web pages and returns those to the client or that it is the DNS server that then connects you to a

website. It was decided that a resource being on an intranet was not an acceptable answer on its own for part (ii) as some kind of DNS query might need to be sent or what the candidate was trying to express was covered elsewhere in the mark scheme. We also decided that IP was not enough for IP address for part this part of the question. Candidates that answered that a DNS sever returns an IP or that you would not need to send a DNS query if you entered an IP did therefore not secure marks.

(c) This part was based around HTTP GET requests and it was pleasing to see that a group of candidates could clearly apply their understanding to these question parts.

(i) This part was answered correctly by the majority of candidates and it was clear that it was understood that a browser would be operating in the application layer.

(ii) Weaker candidates could not supply the correct name of any of the TCP / IP layers. It was pleasing to see that candidates understood that an initial HTTP GET request could just return a HTML file and when processed this might need more HTTP GET requests to retrieve necessary resources such as images, javascript and CSS files to display a web page.

(iii) This part proved hard for candidates to secure a mark and a lot just described a port number and not a client port number therefore not describing what made it a client one. It was pleasing to see the correct answer of a temporary port number being supplied for the duration of a connection being supplied by a few candidates. There does seem to be some confusion around client port numbers with candidates indicating that it can identify a machine on a local network or that the server actually supplies the number to the client.

Q15.

Part (a) was well answered, with the majority of candidates achieving all three marks. Common mistakes were to give IP addresses made up of three octets instead of two, to give a value of zero for the Host ID or to include a port number in an IP address.

For part (b), the overwhelming majority of candidates recognised that this was a bus topology.

For part (c), candidates who knew the correct format of a subnet mask almost always got the right answer but quite a lot of candidates appeared not to know what a subnet mask was at all.

Part (d) was poorly answered, with only about a third of candidates achieving the mark. Many candidates confused a Server Operating System with either a Network Operating System or a Thin Client System. Candidates needed to recognise that a Server Operating System was optimised to allow the server to efficiently deliver services to clients on the network. Well explained examples were also creditworthy, but the example of just loading files was not sufficient as this was given in the question.

A good awareness was shown in part (e)(i) of how to maintain the security of a WiFi network. Answers such as the use of WEP / WAP, disabling the broadcast of the SSID and the use of a MAC whitelist were common. A more problematic answer, offered by many candidates, was the use of a password to connect to the network. This answer was credited if the examiner understood that the “password" was in fact a passphrase entered to encrypt the data on the WEP / WAP connection, but it was not credited if the answer could be interpreted as a logon system. Candidates need to be aware that the passphrase entered is not a password checked against a database of valid passwords but instead, it is

used to calculate the encryption keys that will be used for data transmission. Candidates also need to be aware of the meaning of important keywords in a question such as “describe". A single word or very brief response is unlikely to be creditworthy if a question has asked for a description of something.

Part (e)(ii) was very well answered, with the most popular answer relating to the relative ranges of WiFi and the most common implementation of Bluetooth class. The most common misconception was that only two Bluetooth devices could connect together at once.

Part (f) asked about routing a packet of data from a computer on a LAN to a web server across the Internet. Candidates were expected to explain how the packet would be routed both internally on the LAN and externally on the Internet. Almost all of the mark scheme points were made by some candidates, but very few candidates individually made enough of them. Generally, the routing of packets externally on the Internet was dealt with more successfully than routing on the LAN.

Very few candidates explained how the subnet mask would have been used by the student's computer to identify that the destination web server was not on the same segment as it was, and therefore the packet would first be sent to Router 1. Pleasingly, most candidates recognised that the packet would then be sent on to the gateway but many did not achieve the mark for this point because they failed to explain that this was done because the destination computer was outside of the LAN.

External routing was generally better covered, with candidates explaining how the destination IP address would be used to pass the packet between routers in a hierarchical fashion. A small number of candidates recognised that routing decisions were made by each router (using a routing table) and also explained the distinction between how the IP addresses and MAC addresses would be used.

Common mistakes were to explain about the use of the TCP / IP stack or how packets were formed or to discuss the use of CSMA / CD. These points were not usually wrong, but did not address the question.

For part (g), approximately half of the candidates achieved at least one mark comparing routable and non-routable IP addresses, but few achieved both. Good responses referred to uniqueness, who would issue the IP addresses and whether or not they could be directly reached across the Internet.

Some candidates stated that it was not possible to connect directly to a non-routable IP address. This was not creditworthy as it is possible to connect directly to such an address if you are on the same network. Candidates needed to make clear that they meant “across the Internet" to achieve the mark. Other common mistakes were to give opposing sides of the same point and to confuse the comparison between routable and non-routable IP addresses with comparing static and dynamic IP addresses.

Q16.

Part (a) of the question started by asking students to identify a use of a collection of protocols. The majority of students could correctly identify a use for FTP and it was obvious that this was a well known protocol. Students, however, struggled with both Telnet and POP3. Whilst the majority of students knew that POP3 was concerned with e-mail, this was not considered to be creditworthy as students should be aware of the difference between POP3 and SMTP. Students who did identify that POP3 was concerned with retrieving e-mail from a server were rewarded with the mark. It would be beneficial for students to have access to working with these common protocols so that they can gain a feel of their use.

The first few parts of (b) were answered well by students. Most secured the mark for IP address and port, but providing a socket came out as the hardest of the three parts. The most common incorrect answer for port was 37 with students picking this out from a different column of the figure. In a similar fashion, it was common to see a variety of items taken only from the figure as a guess at socket.

The last part of question was answered well with the majority of students gaining at least one mark. A wide variety of answers were seen across the marking period. Popular answers included the servers being off-site and the point that it would save time being able to access the servers from a desktop rather than travelling to them. Students who realized that the servers might be able to be managed from anywhere with an Internet connection were also awarded a mark.

Q17.

Part (a): Students were required to explain why a server-based network was more appropriate for a college administration system than a peer-to-peer network. Responses that either explained general advantages of a server-based network or that were written in the context of using a centralised database on a server-based network were both given credit. However, many responses were very weak and amounted to little more than stating that the database could be stored on the server. Good responses considered issues such as security, management, concurrency issues and the creation of backups. Just under half of students achieved any marks for this question part.

Part (b): For this question part, students needed to explain how a thin-client network worked and the impact of this on the hardware that should be purchased to implement one. Most students were aware of the fundamental concept that in a thin-client network the majority of processing tasks were completed by the server. Disappointingly, far fewer then went on to explain that the clients would function primarily as input / output devices with the network being used to transmit input and output from the clients to the server and back again. The worst tackled aspect of the question was the description of the impact of the method of operation on the choice of hardware. Students often wrote vague statements such as, "a more powerful server would be required,"or "the clients could be quite weak". At this level, students needed to give specific examples of hardware requirements such as that the server might require multiple processors to deal with the workload or that the clients may not need a hard disk drive. The most neglected aspect of the hardware part of the question was the impact on the network infrastructure of the volume of data that needed to be transmitted. A small but noticeable number of students wrote about the differences between thick and thin-client systems, failing to directly answer the question. Some students also confused thin and thick-client systems with star and bus topologies.

Part (c): About a quarter of students were able to identify that a gateway was used to link together two networks that used different protocols and would perform protocol conversion. A common mistake was to confuse a gateway with a firewall. Many students just restated what they were told in the question, ie that it would be used so that staff could access the network from outside of the college.

Q18.

When describing the role of a router it was common for weaker students simply to point out that it, ‘routes information,’ and, ‘passes information from the client to the server.’ Answers tended to be vague perhaps indicating that this is currently an area of subject matter that is not particularly well known. Students who identified that a router forwards packets from one network to another and who stated that it inspected the destination IP address were awarded the marks.

It was pleasing to see that the majority of students could name a protocol associated with e-mail. Incorrect answers included Telnet, FTP and HTTP but the majority correctly answered with SMTP or POP.

When describing the TCP/IP stack it was clear that the stronger students could place a few points into each of the layers and they were rewarded with high marks. It was common for weaker students to mix points up between layers or to fail to provide enough information.

Q19.

We have previously asked about individual layers of the TCP/IP stack and it was a natural progression to ask candidates to describe the roles of each layer.

It was pleasing to see a large number of candidates being able to provide a good amount of detail about the TCP / IP stack. Good candidates could provide relevant points for each of the layers. Candidates also gained a collection of marks describing the transport layer as the mark scheme allowed a good variety of points to be made. It was surprising to see that some candidates had made no attempt to answer this question indicating that the TCP / IP protocol stack is still an area that needs to be looked at further. Some of the roles of the transport layer, such as breaking the data into packets, should be achievable by the weaker candidates. A group of candidates also used the name of each layer to try to describe its role providing answers such as, 'the network layer does the networking whilst the link layer links...'; these often ended up securing no marks. It was clear that some candidates had an idea of what happened in the TCP / IP stack but could not link the roles to the correct layers and they therefore struggled to gain marks. Other groups of candidates clearly knew that addresses were important, but could not identify that the network layer dealt with IP addresses and the link layer dealt with hardware addresses.

Q20.

Part (a)(i), ii: Approximately two-thirds of candidates responded with an appropriate IP address for each of these question parts. However, as in 2010, a small but significant minority of candidates gave answers that could not possibly be IP addresses.

Part (b): The correct subnet mask was 255.255.255.0. Approximately half of the candidates identified that this was the case.

Part (c): Answers to this question part covered a range of issues: security, reliability and throughput. The most common correct response explained that there would be a reduction in the number of collisions. Candidates needed to ensure that their explanations were sufficiently detailed to achieve both marks.

Part (d)(i): This topic was reasonably well understood, with candidates explaining that cabling costs would be lower as a single cable would run around the entire network. A small but surprising number of candidates believed that a bus network would be faster because only one cable was involved.

Part (d)(ii): There were many good responses, covering issues relating to reliability, security and speed. The most common error was to state that a star topology was more reliable because the failure of a single computer would not affect the others. Rather, it is the limited effect of the failure of a single cable that would improve reliability.
Part (e): Most candidates managed to write lengthy responses to this question part. The quality of these answers was quite variable, with some candidates demonstrating an extensive understanding of network security when connected to the Internet whilst other responses were quite superficial. When answering this type of question candidates need to make sure that they address the entire question. Some candidates lost marks by

focussing only on the security measures that the network manager could put in place, either ignoring or only briefly mentioning the threats to which these would be responses. To achieve marks, candidates needed to describe the threats and measures, not simply name them.

Q21.

Part (a) was answered poorly by the majority of candidates. The role of the transport layer does not seem to be understood to the depth required with candidates producing vague responses. Many candidates used only the diagram to state that the transport layers pass data to and from the other layers which was not enough to gain credit. Some candidates were also confused about the role of each layer, with many stating that IP addresses or MAC addresses were added by the transport layer, when these are functions of other layers. The majority of candidates who secured marks described data being split into packets and the idea of packet sequencing. Better candidates were also aware of the transport layer assigning port numbers.

Part (b) was well answered by the majority of candidates. Common answers were HTTP, HTTPS, Telnet and SMTP. A few candidates identified applications; for example e-mail, rather than protocols, and therefore did not secure the mark.

Part (c) divided the candidates. Many incorrectly stated that a router operated in the link layer. To actually route a packet the router needs to look at IP addresses and therefore operates in the network layer.

Q22.

Although this question has been asked before, candidates struggled to secure full marks for part (a).
Often candidates answered with one or two words, rather then using a full sentence which the question required since it asked for a description. The majority of candidates correctly identified the domain name, but a few still confused this with a Fully Qualified Domain Name (FQDN). Instead of describing the second part it was common to see a candidate state only ‘path’ and therefore not secure the mark. Candidates should be encouraged to use full sentences when the question asks for a description.

Part (b) was answered well by the majority of candidates. A few candidates stated only ‘a rule’, but this was not accepted. It is pleasing to see more candidates use a fuller answer including the communication aspect.

The majority of candidates scored 1 mark for part (c) with only a few securing the second mark. The idea that both an intranet and the Internet use the same protocols is well known, but a few candidates did not secure the mark with an answer stating only that “they both use protocols”. A number of candidates stated only that they were networks or connected computers, but this was not creditworthy.

The majority of candidates secured the mark for part (d) by stating that a FQDN is easier to remember. A few candidates talked themselves out by describing a FQDN as also containing the IP address.
Some candidates responded that using a FQDN was faster when this is not true as the client will need to search for the IP address using DNS. A few candidates also wrote about using a FQDN as being more secure than using an IP address, but this was also not creditworthy.

Q23.

This question concerned the HTTP and HTTPS protocols and for the first time included

questions about the use of ports. The former parts were answered very well with the question about the difference between HTTP and HTTPS being especially well described. However, the same cannot be said about the other two parts of the question on ports, which is a new topic. These were answered very poorly with only a very few candidates gaining full marks. The answers given were often vague and, on the whole, this showed that this part of the specification was not at all well known.

Q24.

Part (a): Many candidates scored full marks by identifying three appropriate IP addresses. A small but not insignificant number of candidates wrote IP addresses consisting of just three decimal numbers, clearly indicating that they did not understand the concept. Candidates also need to be aware that the last octet of an IP address cannot contain certain values. Some lost marks by giving this as either 0 or 255.

Part (b): The overwhelming majority of candidates correctly identified the topology that was used.

Part (c): Many candidates were able to state the subnet mask correctly but few were able to explain its purpose. A commonly held misconception, presumably derived from the word mask, was that it would hide a computer's IP address from other computers. The purpose of the subnet mask is to allow a communicating device to determine whether or not another device that it is communicating with is on the same subnet, so that data can be sent to it directly, or a different subnet in which case communication must be via the router.

Part (d): There were many very good responses to this question. Candidates used the full range of responses that were given in the mark scheme, with the most popular ones being the use of encryption and needing a key to access the network. A small number of candidates lost marks by discussing general network security measures, such as the use of a firewall, when the question had asked specifically about securing the connection to the wireless access point.
Some candidates understood that access could be limited based upon the address of the computer, but thought that the IP address would be used rather than the MAC address and so did not gain credit.

Part (e): Responses to this question part were mixed. The majority of candidates scored some marks, but only a tenth of candidates provided responses that were awarded all six marks.
Some candidates lost marks through weak descriptions. A good example of this is that a certain time is not the same thing as a random time.

The Quality of Written Communication was similar to responses to question part 2b.

Q25.

Answers often fell short of that required. A substantial proportion of answers simply stated “a rule” or “a set of rules”. The former is not enough and this year “a set of rules” was accepted but the answer should really go on to say for data communication/exchange.

Part (b) required candidates to identify the appropriate protocol for various types of communication. Of the four subparts to this question the subparts (iii) and (iv) were those that were answered correctly most frequently. However sometimes for subpart (iv) SHTTP appeared rather than HTTPS. Incorrect answers often stated the layer rather than the appropriate protocol in the answer box. This question had answers ranging from four to zero marks and as such represents a good discriminator. A small but significant number of candidates left the entire answer blank.

Q26.

This question was poorly answered. Many candidates simply stated that the Internet and an intranet were both networks, which was not enough to gain credit. Valid similarities included the use of common protocols and provision of access to similar services. A mistaken belief, widely held, was that an intranet would only be available on a LAN or within a small area. Candidates may form this opinion based on their own practical experiences of a college intranet, but large companies have global intranets that can be accessed worldwide. Many candidates lost marks by only stating one side of a difference, such as that an intranet was private, without making clear that they understood that in contrast the Internet was publicly accessible.

Most candidates were able to give a definition of a protocol or to describe one in sufficient detail to be worthy of credit. Some gave examples of protocols, which by themselves were not creditworthy.

There were a lot of very good responses to the question about the TCP / IP protocol stack. Many candidates were able to name two stack layers and to give examples of layer functions. The most common errors were to name the Transport layer as the Transfer layer and the Data Link layer as the Data layer.

Q27.

(a) Generally this question was consistently well answered.

(b) The marks were given were this time for a description of the feature (not just stating the name of the feature as in previous papers). The most popular answers were 'Page Navigation', 'Favourites', and 'History'. Some candidates did describe a feature which was not browser-specific such as 'Help' or 'Print', ignoring the rubric in the question stem.

(c) Any candidate who had practical experience with website construction would not have found a problem in identifying the use of folders/directories. Wrong answers, including vague answers, were 'by having a home page for each club', 'a home page with links to each club,' or, 'by having the club name at the end of the URL.'

(d) Most candidates achieved the mark, although seriously wrong answers included removable drives, DAT and even 'hard copy'!

Q28.

(a) Few candidates could explain clearly how the default gateway address is used by a host computer. Some confused the default gateway address with a gateway connecting networks with different protocols. Some were under the impression that all messages were sent to the default gateway, whether intended for the same subnet or not.

(b) Most candidates could explain that a domain name server provided an IP address for a requested domain name. Fewer candidates could give a fuller explanation that the domain name server intercepts the domain name and looks up the domain name in its database to find the matching IP address. A small minority correctly stated that if the domain name server can't find the domain name in its database, that it will contact another domain name server.

Q29.

(a) The definition of a protocol is still unknown to a significant minority of candidates,

even though this question has been asked many times.

(b) Only the better candidates could state the missing 2 layers of the TCP/IP protocol stack in the diagram. Among the many creditworthy examples of types of application in the application layer were FTP, telnet etc. However, examples such as word processors were not appropriate.

(c) A pleasing majority of candidates knew that a MAC address was a unique identifier assigned to a network card.

(d) Some candidates did not seem to understand that one part of an IP address is used as the network ID (all devices on the same subnet will have the same network ID) and the other part is used as the host ID (to uniquely identify each device on the same subnet). The bits of the IP address used as network ID corresponds to the bits set to 1 in the subnet mask. The better candidates knew that 0 and 255 are not available as host IDs to assign to networked devices and therefore there are 254 different host IDs. To get more host IDs, the subnet mask should be changed or the network split into different subnets (with different network IDs). A significant number of candidates wrongly suggested that more IP addresses should be registered with the Internet registrar. Private addresses are chosen to avoid massive use of public addresses.

(e) Most candidates gained one mark for stating that a router would be required. A few of the better candidates provided excellent answers such as: the IP address registered with the Internet Registrar is assigned to the Internet facing network card of the router and the local IP address 192.168.4.1 (default gateway) is assigned to the LAN-facing network card of the router. The local computer sends the message to the LAN-facing network card of the router and the router sends the message to the Internet using the registered IP address. The router sends the reply from the Internet to the local computer's private IP address.

Q30.

When any question asks for 'advantages or disadvantages" then candidates should not fall into the trap of the 'quicker/faster/easier' answer.

(a) In this part as well as part (b) the mark scheme had a wealth of acceptable answers and candidates generally scored well, often with answers which came from their own experiences of a school/college network. A common wrong answer was that "only one copy of the software need be purchased".

(c) (i) Most candidates scored the mark for a 'a set of rules" but the suspicion that their understanding went no further than that was confirmed by the answers seen for (ii).

(ii) Candidates who had the basic understanding of a two way exchange of signals or acknowledgments should have been able to score 2 with a general statement, followed by a description of a particular signal. Although not required in this question, candidates should also appreciate that particular lines/wires of the connecting cable will be used to transmit these signals.

(d) There are still some candidates who include the 'www' as part of the domain name. For the first time an answer which included the 'www' as part of the domain name scored zero.

Q31.

This question was straight forward book work but it was very poorly done. Most candidates ignored the fact that there were three marks for part (a) and failed to answer in sufficient depth. Although many candidates had some idea that a server is likely to provide some resource, few were able to describe the client-server relationship.

Most candidates had some knowledge of event driven operating systems but many failed to obtain full marks due to weak explanations. Few candidates showed that they understood the nature of an event in this context.

Q32.

(a) Although peer-to-peer networking is now very popular, few candidates could adequately describe it. It was not sufficient that each computer could send to another without a server. In a true peer-to-peer network there are no dedicated servers. Computers function as both client and server.

(b) Although the question asked for a labelled diagram, some candidates did not gain marks because they did not indicate which of their drawn boxes represented a computer and which the switch and printer. Some candidates substituted the switch for a hub, which did not gain credit. Many others drew a standard bus topology, also not worthy of a mark in this question.

(c) Many candidates correctly stated that computer C was in a different subnet/segment to the others. Some candidates thought computer C was in a different network, for which no credit was given.

A pleasing majority of candidates correctly stated that the network ID of this network was 192.168.5 and that host IDs could be any value in the range 1-254. Credit was also given to those who stated the host IDs could be in the range 0-255, even though 0 refers to all addresses on the subnet and 255 is reserved as the broadcast address.

(d) Many candidates failed to give enough detail to gain credit. It was not enough to state that the router routes data packets from one device to another. Candidates needed to state that the router uses IP addresses to do this.

Many candidates correctly stated that 22.125.105.15 was the correct IP address of the two given, which needed to be registered with the Internet registrar. However, not many could state a clear reason. Responses that gained credit included: because the public address needs to be unique over the whole Internet.

Many candidates could identify that the default gateway IP address was 192.168.5.1.

Q33.

Part (a) was straightforward and correctly answered by the majority of the candidature. The correct answer was Wide Area Network.

In part (b) candidates who were able to think critically were successful. Other candidates were partially successful or not at all. The latter failed to comprehend the stem of question and believed that the on-line service supported the downloading of software, therefore failing to appreciate that the software is run on the central server only. Candidates who stated that the system should prevent the illicit copying of the software or that a customer would not have to keep track of software copies on their own machines gained credit. Other creditworthy answers were that staff would not be required to distribute the product; help-desk support would be simplified when all customers are using the same centrally

managed, shared software; a smaller development team would be possible because different “flavours” of a product would not be required for the different operating systems used by customers; updates implemented without delay because applied centrally.

Q34.

Candidates’ knowledge and understanding of networking at the level of CPT 5 is still a source for concern.

Many candidates were able to define the term protocol correctly getting a mark for referencing a set of rules or procedures. Many were also able to correctly identify the network topology as a bus. In part (c) the examiners were looking for “twisted pair” or “coaxial cable” or “fibre optic”. “Cat 5” was rejected because it is a category of twisted pair. Candidates are advised to avoid manufacturers’ names and instead use generic names. Manufacturers’ names are “here today and gone tomorrow”.

A surprising number of candidates were unable to give sensible examples of IP addresses that could belong to the same network. Candidates must have practical experience that involves examining the IP address of a computer and another computer to which it is connected on the same sub-net. Candidates must also have some practical experience of using a sub-net mask to identify the LAN part and the host part of an IP address. Some candidates lost a mark because they were unable to give four octets or when four octets were given one or more octets were out of range - acceptable range was 0-255.

In part (f) the examiners were looking for an address assigned to network card. This is a hardware address fixed into the card at the time of manufacture. Some candidates described an address assigned to the computer that could easily have been interpreted as an IP address and so did not gain credit.

Some candidates’ understanding of the TCP/IP protocol was not good enough to answer part (g) successfully. The TCP layer allocates port numbers so that when a client receives a response from a server the TCP layer can route the response to the application that sent the corresponding request. The TCP layer will split messages from the application layer into packets and will re-assemble packets received into messages which are then passed to the receiving application. The TCP layer is responsible for error handling, establishing a connection and monitoring this connection. It adds TCP headers to each packet that it sends, incorporating a sequence number into each.

In part (c) many candidates were able to give an example of an application found in the application layer. Popular answers were an Internet browser/HTTP client and a web server but there were many other possibilities. Some candidates wrongly answered word processor and missed the point. The application layer in the TCP/IP protocol stack deals with client/server applications.

Disappointingly, many candidates did not connect the type of organisation responsible for recording the allocation of public IP addresses with the office of an Internet Registrar. Instead, they erroneously answered Internet Service Provider. The latter provides one or more access points to the Internet. The mapping from point of presence on the Internet to individual users of an Internet Service Provider is done via IP addresses allocated by the ISP using blocks of IP addresses registered with an Internet Registrar.

Q35.

In a relational database, relationships are implemented by an attribute common to more than one table, linking those tables. This was often in the form of a primary key in one table being a foreign key in another. They are not implemented by entity relationship diagrams, and the link is between tables, not between databases. An attribute is a

property or characteristic of an entity, or one piece of information about an item. A surprising number of candidates said that an attribute was a characteristic of an entity such as a field length or data type, or that it was a field, without further explanation.

The purpose of data validation is not to make sure the data is correct. Rather it checks that the data is appropriate or reasonable. Two candidates gained this mark for, respectively, 'To check that the data meets requirements' and 'To reduce the chance of incorrect data being entered.' A variety of validation rules were offered, including range checks, presence checks, format checks and actual examples of a validation check on a sailing holiday data base such as the maximum number on one boat being less than a certain number. Many candidates scored their only mark for this question from this part.

The commonest unacceptable answer was input mask. An input mask shows how data should be entered into a field but would not check, for example, that data entered into a date field in the correct format is a valid date.