AQA Computer Science A-Level
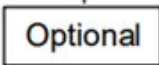# 4.9.4 The Transmission Control Protocol/Internet Protocol (TCP/IP) protocol
Past Paper Mark Schemes

05	1	All marks AO1 (understanding)	3
		Differences (2 marks):	
		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.	

Public	Private
(Globally) unique.	Many computers/devices may have same address.
Allocated by a central/regional issuing authority (**A.** example).	Not allocated centrally // allocated by a home user/company/ISP.
Can be connected to directly <u>over the Internet / from outside private network</u>	Difficult/impossible to connect to <u>over Internet // from outside network</u> // must connect to Internet through router/gateway

Owner can be looked up using WHOIS protocol	Owner cannot be looked up using WHOIS protocol

A. private IP addresses more secure as cannot be connected to over Internet/from outside network
A. cannot identify location from a private IP address

Why combined device needs both (1 mark):

Needs public IP to connect to/be routed to via Internet and private IP to be on same subnet as computers on LAN/to be used as a gateway by computers on LAN / to connect to LAN;

| 05 | 2 | **2 marks AO1 (recall): What NAT is:**

Modifying network / IP addresses (and port numbers); as they pass through a router;

1 mark AO1 (understanding): Why performed:
The private IP addresses used on the LAN are not routable, so cannot be used for routing on the Internet;
The private IP addresses used on the LAN are not unique, so cannot be used by the host to return data;
To improve the security of the LAN;
A. to convert from one address space to another; | 3 |

06	1	**All marks AO3 (programming)**	3
		MemberID INT PRIMARY KEY NOT NULL // MemberID INT PRIMARY KEY(MemberID) [Optional ↑] Forename VARCHAR(20) Surname VARCHAR(20) MaxBooks INT DateOfBirth Date **1 mark** for MemberID, with sensible data type and identified as primary key **1 mark** for two other fields with sensible data types and lengths **OR 2 marks** for all four other fields with sensible data types and lengths **A.** any sensible types. Lengths do not need to be specified. **Valid alternative SQL types are:** • Alternative types For *MemberID*: smallint, mediumint, integer, any text type (see below)	

• Alternative types for *text fields (Surname, Forename)*: char, varchar, nchar, nvarchar, ntext, longvarchar, varchar2, nvarchar2, text, tinytext, mediumtext, longtext

• Alternative types for *MaxBooks*: smallint, mediumint, integer

• Alternative types for *DateOfBirth*: datetime, datetime2, date/time, smalldatetime

Allow lengths after numeric types eg INT(11) as these are allowed in MySQL.

Answers using a syntax that is clearly not SQL should be awarded zero marks. But:

    • **ignore punctuation errors eg unnecessary colons or commas.**

    • **answers in SQL style syntax but using non-SQL data types can be credited but MAX 1 of 2 for data types if any non-SQL types used.**

clauses must be present, but there could be mistakes in the
marks awarded for AO2 e.g. an incorrect or missing condition

Example Solution

```
SELECT BookID, Title, Author, Price,
       Category
FROM Book
WHERE Author = "David Ferguson"
      AND Price < 25
ORDER BY Price DESC
```

Additional Guidance

AO2 marks:

Mark(s) can be awarded for the correct logical conditions even if
the required table is not identified as being used by the query

AO3 marks:

Accept table names before fieldnames.
Accept use of `Alias/AS` command eg `FROM Book AS B` or
`FROM Book B` then use of `B` as table name.
Accept `INNER JOIN` written as one word i.e. `INNERJOIN`
Accept `ORDER BY` written as one word i.e. `ORDERBY`.
Accept insertion of spaces into fieldnames.
Accept use of currency formatting for the 25 value.
Ignore unnecessary brackets.
DPT. for unnecessary punctuation – allow one semicolon at the
very end of the statement, but not at the end of each clause.
DPT. for fieldname before table name.

| 06 | 3 | **Mark is for AO1 (knowledge)** | 1 |
| | | Read; **A.** Retrieve | |

| 06 | 4 | **Mark is for AO1 (understanding)** | 1 |
| | | Representation 1; **R.** if both lozenges shaded | |

06	5	**Marks are for AO1 (understanding)** More compact; Structure understood directly in some languages (eg Javascript, Python); Easier for computers to parse // quicker to parse; Easier to create; **MAX 2**	2

January 2010 Comp 2

8	(a)		Set of rules/agreed signals/agreed codes (for data exchange between systems) **R** instructions	1

8	(b)		(i)	Managing a server remotely.	Telnet/SSH/SSH2/RSH **A** HTTP/HTTPS if not used in (iii) or (iv)	
			(ii)	Retrieving email 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

January 2011 Comp 2

9	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

9	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

9	c		Network (layer); **A** IP (layer)	1

January 2012 Comp 2

5	b		SMTP; POP(3); IMAP(4); **A** full names of the protocols above	MAX 1	**A** ESMTP // SMAP // LMTP // QMTP

5	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 figure 6 to match up with statements above | | |

June 2010 Comp 2

2	(a)	(i)	Hypertext Transfer Protocol; **A** Hypertext as two words	1

2	(a)	(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**	1

2	(a)	(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

2	(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; **MAX 1** **A** Port number 1024 - 4095	1

2	(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**	2

June 2011 Comp 2

5			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;	

June 2011 Comp 3

8	(a)	(i)	192.168.0.x where x is not 0 or 255;	1
8	(a)	(ii)	192.168.2.x where x is not 0 or 255;	1
8	(b)		255.255.255.0;	1

June 2012 Comp 2

3	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
3	a	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
3	a	iii	To retrieve/fetch (stored) email; To check for <u>new</u> emails; **A** access/download/receive **R** sending **TO** any mention of sending **NE** just "email"	1

3	b	i	192.168.3.205 // 74.125.4.148 // 208.43.202.29;	1
3	b	ii	80 // 25 // 58539 // 57458 // 57459; **I** colons	1
3	b	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

3	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

4	a		*Imperative:* Instructions are executed in a programmer defined sequence // Instructions specify how to solve the problem; **A** executed line by line (in sequence) *HLL:* A language that uses English-like/more meaningful keywords // one instruction maps to several machine code instructions // has structures for assignment/iteration/selection ; **NE** a language that is like English	2

8	(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	
			Accept the opposite of points e.g. for "Slower processor" accept "a thick client system would need a faster processor".	

5			Company will need to register/purchase the domain (with an Internet registrar);	
			DNS records will need to be setup // IP address needs to be linked to domain name // www.learncomputing.co.uk set to point to 123.45.67.100;	
			(Using telnet) company will need to install web-server / ftp-server onto the server; Web-server configured for root web folder; These services will need to be started on the server; Each service will be allocated a port to listen on; The web server should be set to run on port 80 // FTP set to run on port 21/20;	MAX 6
			Web pages written in HTML / hyperlinked pages / CSS; Cascading style sheets/CSS used to control layout/presentation; upload to the server files using FTP (client);	
			After the DNS records have propagated around Internet users will be able to access website;	
			Company may wish to perform some search engine optimization (SEO) to allow user to easily find site;	

7	(d)		That data is not being encrypted // data is not being sent securely // that hackers might be able to see personal data;	
			A. the protocol/it is not secure **R.** website not secure	2
			HTTPS // HyperText Transfer Protocol Secure;	

June 2017 Paper 2

09	1	**All marks AO1 (understanding)**	2
		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;	

June 2009 Comp 2

	(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 <u>IP</u> 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

5	(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

5	(a)	(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

5	(a)	(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

5	(c)		255.255.255.0 / FFFFFF00 / 11111111 11111111 11111111 00000000;	1

| 5 | (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. | 2 | |

Routable	Non-Routable
(Globally) unique.	Many computers/devices may have same address.
Allocated by a central/regional issuing authority (**A** example).	Not allocated centrally // allocated by a home user/company/ISP.
Can be connected to directly <u>over the Internet / from outside private network</u>	Difficult/impossible to connect to <u>over Internet //</u> <u>from outside of network</u>.
Owner can be looked up using WHOIS protocol	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

Specimen Paper 2

04	1	**All marks AO2 (apply)**		12

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 four areas indicated in the guidance below and in at least three of these areas there is sufficient detail to show that the student has a good level of understanding of the technologies required. A good level of understanding would be indicated by three substantiated points being made per area. To reach the top of this mark range, a good level of understanding must be shown of all four areas.	10-12
3	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response but the response may only cover three of the areas indicated in the guidance below, with two or three substantiated points being made per area.	7-9
2	A limited attempt has been made to follow a line of reasoning by covering at least two of the topic areas in the guidance below. Overall, at least four valid points must have been made which can relate to any of the topic areas in the guidance.	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 four areas from the guidance or may be made in a superficial way with little substantiation.	1-3

Guidance – Indicative Response

1. Fridge capturing data from food

RFID well suited as completely automatic short-range wireless transmission so no user involvement

- tag does not contain a power source but is energised by reader in fridge
- this causes wireless transmission of data stored in memory on tag to reader

Alternatively, scan barcode/QR code as food put into fridge

Barcode less suitable than RFID as only identifies product not use by date and must be manually scanned

Problem of how to deal with untagged produce – possible use of voice recognition or touch screen interface

Can identify products and potentially track use by dates, but how to work out how much of the product is left – refrigerators redesigned with load cells to weigh items automatically?

2. Networking technologies

IPv4 does not have a big enough address space for the number of devices, hence introduction of Ipv6

Higher bandwidth Internet connections required for so many devices

- copper-based transmission systems replaced with fibre optic

Need for a standard (application layer) protocol for devices

Security issues with many devices connected to Internet that could be hacked

Would data be communicated to retailers directly from each device or through a server in the home?

Need to consider how to deal with interference between wireless devices, collisions etc with many more devices communicating

3. The data gathered and storage

Automatic collection of data from devices will produce vast amounts of data

This volume of data would be classified as big data

May also be classified as big data due to the velocity of data collection with so many devices

Storage could be cloud based for flexibility or close to processing cores for speed

Velocity at which data generated would make solid state storage appropriate as has fast access speeds but volume of data and lower cost per megabyte of hard disk storage may mean hard disks more likely to be used

Need to consider how long to keep data for in context of

- Storage capacity available
- Complying with relevant laws about privacy

4. Processing

		Volume of data means parallel processing or distributed processing architectures required	
		Volume of data collected makes it unsuitable for processing by traditional relational databases	
		Functional programming is one approach that could be used	
		Functional programming appropriate as works well on parallel processing systems as programs do not specify order of execution	
		Would software that managed contents of the fridge be run as embedded system in fridge or in the cloud / by the retailer?	
		Retailers may develop a standard API to interface with devices	

06	6	**All marks AO1 (understanding)** **1 mark:** Can't know what type of processor will be in user's computer//Internet users have range of computers/devices with different processors; **A.** References to just different types of computer/device rather than specifically processors **1 mark:** A compiled program will only execute on a processor of specific type/family/with same instruction set//A program run using an interpreter can execute on a computer with any type of processor; **R.** No compiler exists	2

07	1	**All marks AO1 (understanding)** **1 mark:** The 'Router 2' port labelled **A**: 192.168.2.x where x is not 0 or 255; **1 mark:** The computer network interface card labelled **B**: 192.168.2.y where y is not 0 or 255 or x from the previous response;	2