

INTERNATIONAL GCSE **COMPUTER SCIENCE**

9210/2

Paper 2 Concepts and principles of computer science

Mark scheme

June 2024

Version: 1.0 Final



Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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How to mark

Aims

When you are marking your allocation of scripts your main aims should be to:

- recognise and identify the achievements of students
- where relevant, place students in the appropriate mark band and in the appropriate part of that mark band (high, low, middle) for **each** assessment objective
- record your judgements with brief notes, annotations and comments that are relevant to the mark scheme and make it clear to other associates how you have arrived at the numerical mark awarded for each assessment objective
- ensure comparability of assessment for all students, regardless of question or examiner.

Approach

It is important to be **open minded** and **positive** when marking scripts.

The specification recognises the variety of experiences and knowledge that students will have. It encourages them to study computer science in a way that is relevant to them. The questions have been designed to give them opportunities to discuss what they have found out about computer science. It is important to assess the quality of **what the student offers**.

Do not mark scripts based on the answer **you** would have written. The mark schemes have been composed to assess **quality of response** and not to identify expected items of knowledge.

Assessment Objectives

This component requires students to:

AO1: Demonstrate knowledge and understanding of the key concepts and principles of computer science.

AO2: Apply knowledge and understanding of key concepts and principles of computer science.

AO3: Analyse problems in computational terms in order to develop and test programmed solutions and demonstrate an understanding of programming concepts.

The following annotation is used in the mark scheme.

; means a single mark

// means alternative response

/ means an alternative word or sub-phrase

A means acceptable creditworthy answer

R means reject answer as not creditworthy

NE means not enough

I means ignore

DPT in some questions a specific error made by a candidate, if repeated, could result in the loss of more than one mark. The **DPT** label indicates that this mistake should result in a candidate losing only one mark, on the first occasion that the error is made.

Provided that the answer remains understandable, subsequent marks should be awarded as if the error was not being repeated.

Question	Part	Marking guidance	Total marks
01	1	1001 0110;	1 AO2=1

Question	Part	Marking guidance	Total marks
01	2	0100 1100;	1 AO2=1

Question	Part	Marking guidance	Total marks
01	3	0011 0101;	1 AO2=1

Question	Part	Marking guidance	Total marks
01	4	Award one mark for any 8-bit binary number that has a 1 in the leftmost digit.	1 AO2=1

Question	Part	Marking guidance	Total marks
01	5	1100;1001;	2 AO2=2

Question	Part	Marking guidance	Total marks								
02	1	Award one mark for each correctly stated method (Max 2) and one mark for each correct explanation of how the method improves performance (Max 2). Marks cannot be awarded for explanations unless the relevant method has been stated. <table><tr><th>Method</th><th>How Improves Performance</th></tr><tr><td><u>More</u> cores</td><td>More instructions can be executed simultaneously A. tasks, programs for "instructions"</td></tr><tr><td><u>More</u> cache memory</td><td>Cache memory is faster (to access) than main memory/RAM // larger cache memory means main memory/RAM needs to be accessed less frequently // there is a higher probability that instructions/data required will be in the cache A. instructions can be fetched (from cache) more quickly A. more instructions can be pre-fetched NE. more instructions can be stored in cache R. comparisons to secondary storage</td></tr><tr><td><u>Increase</u> clock speed</td><td>Each instruction will execute more quickly // (each cycle/stage of) the F-E cycle will take less time // more times at which an action/instruction can start NE. task for "instruction" NE. more instructions can be executed per unit of time</td></tr></table> Max 4	Method	How Improves Performance	<u>More</u> cores	More instructions can be executed simultaneously A. tasks, programs for "instructions"	<u>More</u> cache memory	Cache memory is faster (to access) than main memory/RAM // larger cache memory means main memory/RAM needs to be accessed less frequently // there is a higher probability that instructions/data required will be in the cache A. instructions can be fetched (from cache) more quickly A. more instructions can be pre-fetched NE. more instructions can be stored in cache R. comparisons to secondary storage	<u>Increase</u> clock speed	Each instruction will execute more quickly // (each cycle/stage of) the F-E cycle will take less time // more times at which an action/instruction can start NE. task for "instruction" NE. more instructions can be executed per unit of time	4 AO1=4
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Question	Part	Marking guidance	Total marks
02	2	<u>CPU/control unit/processor</u> retrieves/fetches (next) instruction from (main) <u>memory</u>; Note: At least one of <u>CPU/control unit/processor</u> or <u>memory</u> must be referenced in the response to award the mark, but it is not necessary for both to be. R. "data" instead of "instruction" A. "instructions" as BOD A. "ROM" or "RAM" for "memory" A. more specific actions that go beyond specification, such as incrementing program counter.	1 AO1=1

Question	Part	Marking guidance	Total marks
02	3	#Carry out the instruction; A. instructions R. task, data NE. execute the instruction Read any data required (by the instruction) from (main) memory / register; #(ALU may) carry out calculations or comparisons; Store <u>result of instruction</u> in (main) memory / register; NE. data Note: The two marks point indicated with a # can only both be awarded if the ALU is named in the second point A. more specific actions that go beyond specification Max 2	2 AO1=2

Question	Part	Marking guidance	Total marks
03	1	AND (gate);	1 AO1=1

Question	Part	Marking guidance	Total marks
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03	2	<table><tr><th colspan="3">Inputs</th><th colspan="3"></th><th>Output</th></tr><tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>Q</th></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td></tr></table>						Inputs						Output	A	B	C	D	E	F	Q	0	0	1	0	0	1	0	1	0	0	1	0	1	1	1	1	0	1	0	1	1	1	1	1	1	1	0	0	3 AO2=3
		Inputs						Output																																										
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		0	0	1	0	0	1	0																																										
		1	0	0	1	0	1	1																																										
		1	1	0	1	0	1	1																																										
		1	1	1	1	1	0	0																																										
Award marks for values in columns D, E, F and Q: 1 mark: 1 column correct OR 2 marks: 2 or 3 columns correct OR 3 marks: 4 columns correct																																																		

Question	Part	Marking guidance	Total marks
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03	3	$Q = (R + S) \cdot \bar{T}$ 2 marks for fully correct expression OR 1 mark for at least one of: • bracket inserted immediately after R + S and another logic gate outside brackets • AND operator with NOT T or T • NOT T included in expression.	2 AO2=2
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Question	Part	Marking guidance	Total marks
04	1	A mapping of characters/symbols/letters to (unique) numbers / binary numbers / codes; A. the binary patterns / numbers used to represent characters/symbols/letters	1 AO1=1

Question	Part	Marking guidance	Total marks															
04	2	1 mark: Row D ticked. A. symbol other than tick as long as meaning clear R. if more than one row ticked	1 AO1=1															
		<table><tr><td></td><td></td><td>Tick one</td></tr><tr><td>A</td><td>Authentication</td><td></td></tr><tr><td>B</td><td>Hexadecimal</td><td></td></tr><tr><td>C</td><td>Sampling</td><td></td></tr><tr><td>D</td><td>Unicode</td><td>✓</td></tr></table>			Tick one	A	Authentication		B	Hexadecimal		C	Sampling		D	Unicode	✓	
		Tick one																
A	Authentication																	
B	Hexadecimal																	
C	Sampling																	
D	Unicode	✓																

Question	Part	Marking guidance	Total marks
04	3	2 marks for fully correct answer: B3d R. incorrect case OR 1 mark for one of: - At least one symbol (B, 3 or d) correct - ignore number of symbols and positions - Correct decimal values of each character shown in working: 66, 51, 100	2 AO2=2

Question	Part	Marking guidance	Total marks								
05	1	First value power correct and coefficient column correct; Final value of power and the output both correct; I. values repeated in a column I. empty cells Max 1 if any incorrect values in table <table><tr><th>Coefficient</th><th>Power</th></tr><tr><td>3</td><td>3</td></tr><tr><td>9</td><td>2</td></tr><tr><td></td><td></td></tr></table> OUTPUT: <u>9x^2</u>	Coefficient	Power	3	3	9	2			2 AO2=2
Coefficient	Power										
3	3										
9	2										

Question	Part	Marking guidance	Total marks
05	2	12;	1 AO2=1

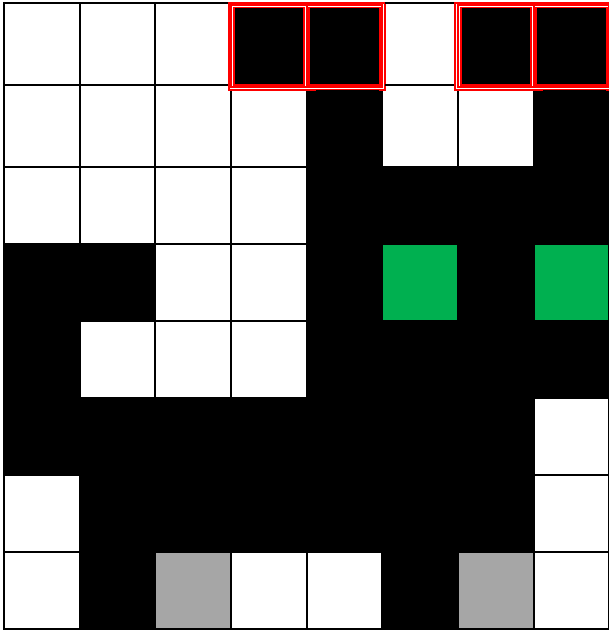
Question	Part	Marking guidance	Total marks
05	3	8x;	1 AO2=1

Question	Part	Marking guidance	Total marks															
06		1 mark: Row A ticked. A. symbol other than tick as long as meaning clear R. li more than one row ticked <table><thead><tr><th></th><th>Statement</th><th>Correct statement (tick one)</th></tr></thead><tbody><tr><td>A</td><td>Algorithm 1 is more efficient than Algorithm 2.</td><td>✓</td></tr><tr><td>B</td><td>Algorithm 2 is more efficient than Algorithm 1.</td><td></td></tr><tr><td>C</td><td>Both algorithms have the same efficiency.</td><td></td></tr><tr><td>D</td><td>It is not possible to work out which algorithm is the most efficient.</td><td></td></tr></tbody></table> Reason Must have selected option A to award mark for Reason It will execute quicker // it will execute fewer instructions; A. carry out fewer calculations A. responses in context of given algorithms eg 100 additions vs 3 additions A. machine code equivalent is likely to require less memory NE. fewer instructions NE. does not contain a loop		Statement	Correct statement (tick one)	A	Algorithm 1 is more efficient than Algorithm 2.	✓	B	Algorithm 2 is more efficient than Algorithm 1.		C	Both algorithms have the same efficiency.		D	It is not possible to work out which algorithm is the most efficient.		2 AO2=2
	Statement	Correct statement (tick one)																
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C	Both algorithms have the same efficiency.																	
D	It is not possible to work out which algorithm is the most efficient.																	

Question	Part	Marking guidance	Total marks
07	1	A single point/dot (in an image); A. square, block, box as BOD The smallest addressable part of a (bitmapped) image; Max 1	1 AO1=1

Question	Part	Marking guidance	Total marks
07	2	Number of bits used to represent each pixel/colour;	1 AO1=1

Question	Part	Marking guidance	Total marks
07	3	1 mark: Row A ticked. A. symbol other than tick as long as meaning clear R. if more than one row ticked	1 AO2=1

Question	Part	Marking guidance	Total marks
07	4	Four cells indicated with red outline below shaded in; A. alternatives to shading cells as long as intended meaning is clear. A. an extra row of pixels added above the image I. colour of shaded cells R. if any other cells shaded in by student 	1 AO2=1

Question	Part	Marking guidance	Total marks
07	5	800;;; If final answer not correct award one mark for each of the below, maximum of two marks: - stating colour depth is 8 - multiplying the number of pixels (800 000 or 1000×800) by their calculated/stated colour depth (A. 200) - dividing by 8 and 1000 or dividing by 8000	3 AO2=3

Question	Part	Marking guidance	Total marks																								
07	6	1 mark: Row B ticked. 1 mark: Row G ticked. A. symbol other than tick as long as meaning clear R. if more than two rows ticked <table><thead><tr><th></th><th>Statement</th><th>Correct statement (tick two)</th></tr></thead><tbody><tr><td>A</td><td>A user's password is often compressed before being stored.</td><td></td></tr><tr><td>B</td><td>Compressed data takes less time to transmit from one computer to another.</td><td>✓</td></tr><tr><td>C</td><td>Compressed files can only be opened on the computer on which they were compressed.</td><td></td></tr><tr><td>D</td><td>Compression is used to prevent data from being read by unauthorised people.</td><td></td></tr><tr><td>E</td><td>Compression is used to reduce risks from social engineering.</td><td></td></tr><tr><td>F</td><td>Data held on solid-state storage cannot be compressed.</td><td></td></tr><tr><td>G</td><td>Huffman coding is a compression method.</td><td>✓</td></tr></tbody></table>		Statement	Correct statement (tick two)	A	A user's password is often compressed before being stored.		B	Compressed data takes less time to transmit from one computer to another.	✓	C	Compressed files can only be opened on the computer on which they were compressed.		D	Compression is used to prevent data from being read by unauthorised people.		E	Compression is used to reduce risks from social engineering.		F	Data held on solid-state storage cannot be compressed.		G	Huffman coding is a compression method.	✓	2 AO1=2
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Question	Part	Marking guidance	Total marks
07	7	AAABBBBAAAA; I. spaces I. case	1 AO2=1

Question	Part	Marking guidance	Total marks
07	8	1 mark: calculating/stating the number of bits used to represent an ASCII character: 7 $77 \div 11 = 7$ bits per character // ASCII uses 7 bits per character 1 mark: calculating the number of bits used to represent a run-length: 8 $45 - (3 * 7) = 24$ $24 \div 3 = 8$ bits per run-length	2 AO2=2

Question	Part	Marking guidance	Total marks
07	9	12 00, 1 11, 2 00, 1 11;; If final answer not correct award maximum one mark for any of: - at least two correct parts of answer in correct order eg 2 00, 1 11 12 W, 1 B, 2 W, 1B 8 W, 4W, 1B, 2W, 1B 8 00, 4 00, 1 11, 2 00, 1 11 12 00 and 2 00 in answer with no counts shown for black pixels ie 12 00, 11, 2 00, 11 8 00, 4 00, 2 00 in answer with no counts shown for black pixels ie 8 00, 4 00, 11, 2 00, 11 <u>Alternative Response</u> 24 0, 2 1, 4 0, 2 1;; If final answer not correct award maximum one mark for any of: - at least two correct parts of answer in correct order eg 2 1, 4 0 16 0, 8 0, 2 1, 4 0, 2 1 A. order of colour and count swapped A. counts given in binary instead of decimal I. missing separators or use of different separator to comma	2 AO2=2

Question	Part	Marking guidance	Total marks
08	1	(A database that has) multiple tables; R. multiple databases that have been linked together // that are related; DPT. use of “databases” for “tables”	2 AO1=2

Question	Part	Marking guidance	Total marks
08	2	SELECT ID, Opening FROM Player, Game WHERE Country = 'Hungary' AND (Lastname = WhitePlayer OR Lastname = BlackPlayer) 1 mark: correct SELECT statement. 1 mark: correct FROM statement. 1 mark: WHERE with one correct condition 1 mark: fully correct WHERE statement // correct use of INNER JOIN A. brackets missing R. missing quotation marks around Hungary I. case, spacing, minor spelling errors, table name before fieldname DPT. fieldname before table name Alternative response SELECT ID, Opening FROM Player INNER JOIN Game ON Lastname = WhitePlayer OR Lastname = BlackPlayer WHERE Country = 'Hungary'	4 AO2=4

Question	Part	Marking guidance	Total marks
08	3	UPDATE Game SET WhiteResult = 0.5 WHERE Round = 2 1 mark: correct UPDATE statement. 1 mark: correct SET statement. 1. case, spacing, minor spelling errors, table name before fieldname	2 AO2=2

Question	Part	Marking guidance	Total marks
09	1	Advantages of wired network (max 3 marks) Faster data transmission / faster network speed; More secure; NE. safer Less likely to suffer from interference; A. more reliable, stable connection Not limited to range based on strength of signal; Disadvantages of wired network (max 3 marks) More difficult to connect additional devices; Can only use a device where there is a network socket; A. more limited where you can use a device // cannot stay connected when moving around R. the network itself is less portable Trailing wires / trip hazards; Can be more expensive/disruptive/complex to install/maintain; Accept points expressed about a wireless network eg wireless network has slower data transmission. Max 4	4 AO1=4

Question	Part	Marking guidance	Total marks
09	2	Faster access/loading/saving; NE. just “faster” Lower power consumption; Less vulnerable to physical shocks; A. more robust/reliable Physically lighter/smaller; A. more portable Generates less heat; Quieter/noiseless; Higher capacity drives available; NE. more storage Higher storage density; A. not affected by magnetic fields Max 2	2 AO1=2

Question	Part	Marking guidance	Total marks
09	3	(Nearly) unlimited storage capacity; A. more storage capacity A. storage capacity can be easily expanded Easy integration with cloud computing services; Makes working from home easier for employees // data accessible from anywhere; Might reduce hardware costs; NE. cheaper Reduced need for in-house technical skills; Maintenance work / back-ups / malware protection done for them // security managed for them; NE. more secure Max 2 R. answers that would also apply to storing files on a central server on the network, eg make it easier to work collaboratively, unless they are expanded to make distinct from storing on a server, eg make it easier to work collaboratively with other businesses	2 AO1=2

Question	Part	Marking guidance	Total marks
10	1	(A program / file / piece of software that): • is attached to another file/program; • executes when the file/program it is attached to is opened / program is executed; • makes copies of itself / spreads / replicates; • (when executed) causes harm to a computer system / other files; Max 3	3 AO1=3

Question	Part	Marking guidance	Total marks
10	2	Trojan; spyware; adware; worm; ransomware; rootkit; Max 1	1 AO1=1

Question	Part	Marking guidance	Total marks
11	1	<pre> <html> <head> <<u>title</u>>Hardware</<u>title</u>> </head> <body> <<u>h1</u>>Printer Types</<u>h1</u>> <p>The two main types of printers are:</p> <<u>ul</u>> Laser Inkjet </<u>ul</u>> <p>Here is a <<u>em</u>>laser</<u>em</u>> printer:</p> <p><<u>img</u> src = "laser.jpg" /></p> </body> </html> </pre> 1 mark: title and /title 1 mark: h1 and /h1 A. number 2 or 3 instead of 1 as long as consistently used 1 mark: ul and /ul 1 mark: em and /em A. i and /i 1 mark: img	5 A02=5

Question	Part	Marking guidance	Total marks
11	2	HTML creates the structure/content of a web page; CSS changes the layout of a web page; A. “style”, “appearance”, “format” for “layout” A. by example if at least three things that CSS can do are listed	2 A01=2

Question	Part	Marking guidance	Total marks
11	3	(On a) server/server-side;	1 AO1=1

Question	Part	Marking guidance	Total marks																		
11	4	1 mark: Row A ticked. A. symbol other than tick as long as meaning clear R. if more than one row ticked <table><thead><tr><th></th><th>Task</th><th>Tick one</th></tr></thead><tbody><tr><td>A</td><td>Check if two passwords are the same length.</td><td>✓</td></tr><tr><td>B</td><td>Create a hyperlink between two web pages.</td><td></td></tr><tr><td>C</td><td>Display an image.</td><td></td></tr><tr><td>D</td><td>Make text bold.</td><td></td></tr><tr><td>E</td><td>Set the colour of a list of points.</td><td></td></tr></tbody></table>		Task	Tick one	A	Check if two passwords are the same length.	✓	B	Create a hyperlink between two web pages.		C	Display an image.		D	Make text bold.		E	Set the colour of a list of points.		1 AO1=1
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Question	Part	Marking guidance	Total marks
12	1	Software/program/code that controls/manages the operation of a computer; A. runs // helps to run the computer	1 AO1=1

Question	Part	Marking guidance	Total marks
12	2	Word processor / spreadsheet / database; A. any example of a piece of software that performs a user-oriented task.	1 AO1=1

Question	Part	Marking guidance	Total marks
13	1	4;	1 AO1=1

Question	Part	Marking guidance	Total marks																		
13	2	1 mark: Row D ticked. A. symbol other than tick as long as meaning clear R. if more than one row ticked <table><tr><td></td><td>Protocol</td><td>Tick one</td></tr><tr><td>A</td><td>FTP</td><td></td></tr><tr><td>B</td><td>HTTP</td><td></td></tr><tr><td>C</td><td>HTTPS</td><td></td></tr><tr><td>D</td><td>IMAP</td><td>✓</td></tr><tr><td>E</td><td>SMTP</td><td></td></tr></table>		Protocol	Tick one	A	FTP		B	HTTP		C	HTTPS		D	IMAP	✓	E	SMTP		1 AO1=1
	Protocol	Tick one																			
A	FTP																				
B	HTTP																				
C	HTTPS																				
D	IMAP	✓																			
E	SMTP																				

Question	Part	Marking guidance	Total marks												
13	3	Award 1 mark for the statement of either side of a difference from the table.	1 AO1=1												
		<table><tr><th>TCP</th><th>UDP</th></tr><tr><td>TCP is connection-oriented</td><td>UDP is connectionless</td></tr><tr><td>TCP server maintains state</td><td>UDP is stateless</td></tr><tr><td>TCP provides a reliable connection A. checks packets received (correctly) A. sends/waits for acknowledgement</td><td>UDP does not guarantee that packets will arrive (in order) // best effort protocol</td></tr><tr><td>TCP performs error recovery // packets received with errors are retransmitted</td><td>UDP does not perform error recovery // packets with errors are just discarded</td></tr><tr><td>TCP has slower (effective) transmission speeds (because of error correction overhead)</td><td>UDP has faster (effective) transmission speeds (as errors not corrected)</td></tr></table>		TCP	UDP	TCP is connection-oriented	UDP is connectionless	TCP server maintains state	UDP is stateless	TCP provides a reliable connection A. checks packets received (correctly) A. sends/waits for acknowledgement	UDP does not guarantee that packets will arrive (in order) // best effort protocol	TCP performs error recovery // packets received with errors are retransmitted	UDP does not perform error recovery // packets with errors are just discarded	TCP has slower (effective) transmission speeds (because of error correction overhead)	UDP has faster (effective) transmission speeds (as errors not corrected)
		TCP		UDP											
		TCP is connection-oriented		UDP is connectionless											
		TCP server maintains state		UDP is stateless											
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		TCP performs error recovery // packets received with errors are retransmitted		UDP does not perform error recovery // packets with errors are just discarded											
		TCP has slower (effective) transmission speeds (because of error correction overhead)		UDP has faster (effective) transmission speeds (as errors not corrected)											

Question	Part	Marking guidance	Total marks
13	4	Setting up the communication between the two hosts/computers // establishing an end-to-end connection; Agreeing settings (at the start of a communication); A. agree language A. agree packet size Error checking/control; Congestion management; Splits data up into packets // recombines data from packets; Adds packet header; A. examples of data in header eg sequence number Passes data to correct application in application layer; Max 2	2 AO1=2

Question	Part	Marking guidance	Total marks
13	5	Route packets across the network // select path that packets are sent across network on // address and package data for transmission; A. adds (source/destination) IP addresses NE. sends data across the network	1 AO1=1