

General Certificate of Education (A-level) June 2011

## Computing

COMP3

(Specification 2510)

Unit 3: Problem Solving, Programming, Operating Systems, Databases and Networking

## Final

## Mark Scheme

Mark schemes are prepared by the Principal Examiner 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 examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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.

Further copies of this Mark Scheme are available from: aqa.org.uk

Copyright © 2011 AQA and its licensors. All rights reserved.

## Copyright

AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334). Registered address: AQA, Devas Street, Manchester M15 6EX. The following annotation is used in the mark scheme:

- means a single mark
- ; // - means alternative response
- 1 - means an alternative word or sub-phrase
- means acceptable creditworthy answer Α
- means reject answer as not creditworthy R
- NE - means not enough
- means ignore I
- 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 only result in a candidate losing 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.

1	(a)			1						
		Positio	n Value	Order E	xamined In					
		8	Philip		1	;				
		10	Ravi		3					
		11	Richard		4	; >;				
		12	Timothy		2					
		1 mark fo 1 mark fo 1 mark fo Do not a	or row 8 corrector row 11 corrector row 11 corrector both rows 10 <b>ward mark for</b>	t ct ) and 12 correct r <b>a particular nu</b>	ımber if same	number is				
		written n	nore than onc	e			3			
1	(b)	8					1			
1	(c)				1					
		Order o	f complexity	Tick one box						
		0	(log <sub>2</sub> n)	$\checkmark$						
			O(n)							
			O(n <sup>2</sup> )							
		Do not a	Do not award mark if more than one box ticked							

2	(a)	Interactive OS: User and computer in direct/two-way communication // User makes input to computer then waits for output before making next input; A system, software, program, OS for computer Network OS: (Layer of software that) redirects requests to remote resources; (A examples) in a way that is transparent to user; Must make one point about interactive and one point about network	Max 2
2	(b)	Flow of program/execution sequence determined by events // program executes relevant code-handling block/procedure/sub-routine in response to events; Example of event such as clicking a button; Message sent to program when event occurs; System loop executes until application closes; this receives and processes messages // use of event-listener/handler; If several events occur they are queued;	Max 2

3	(a)	0 • 1         0         0         0         0         0         1         0         0         0           Mantissa         Exponent	
		<ol> <li>mark for correct mantissa</li> <li>mark for correct exponent</li> </ol>	2
3	(b)	<ul> <li>1 method mark for either: <ul> <li>showing correct value of both mantissa and exponent in denary</li> <li>showing binary point shifted 2 places to right in binary number</li> <li>indicating that final answer calculated using answer = mantissa x 2<sup>exponent</sup></li> </ul> </li> <li>1 mark for correct answer <ul> <li>Mantissa = -0.625 // -5/8</li> <li>Exponent = 2</li> <li>Answer = -2.5 // -21/2</li> </ul> </li> </ul>	2
3	(c)	0       1       1       0       0       1       1       0       0       1       0       0       1       0       0       1       0       0       1       0       0       1       0       0       1       0       0       1       0       0       1       0       0       1       0       0       1       0       0       1       0       0       1       0       0       1       0       0       1       0       0       1       1       0       0       1       0       0       1       0       0       1       0       0       1       1       0       0       1       0       0       1       1       0       0       1       1       0       0       1       1       0       0       1       1       0       0       1       1       0       0       1       1       0       0       1       1       0       0       1       1       0       0       1       1       0       0       1       1       0       0       1       1       0       0       1       1       0       1	2
3	(d)	Maximises precision/accuracy for given number of bits; Note: Must have concept of given number of bits or an example of this e.g. word length. Unique representation of each number // simpler to test for equality of numbers;	2
3	(e)	Reduced precision; Increased range; <b>A</b> can represent larger/smaller numbers No effect on amount of memory required to represent a number;	Max 2

		1													
4	(a)		Current State	S <sub>1</sub>	S <sub>1</sub>	S <sub>2</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>5</sub>	]	
			Input Symbol	0	1	0	1	0	1	0	1	0	1		
			Next State	S <sub>2</sub>	S <sub>3</sub>	<b>S</b> <sub>2</sub>	S <sub>4</sub>	S₃	S₃	S₄	S₅	S₅	S₄		
			1 mark for all fou A the two column	ur bo ns fo	lded r S₄ €	colur either	nns c ˈway	corree rour	ct id an	d sin	nilar f	for S <sub>t</sub>	5		1
4	(b)		Accept/Accepting/Accepted (state) // Input (string) is accepted <b>A</b> if the FSA finishes in this state output is Yes <b>R</b> Stop state										1		
4	(c)		Input String		Strin	g Ac	cept	ed?	(Yes	/No)					
			101			U	N	o							
			000				N	o							
			010001101				N	o							
			0100011011				Ye	es							
			1 mark for any two correct answers 2 marks for all four answers correct											2	
4	(d)		Strings that start with a 0; A does not start with 1 R starts with 00, 01, any statement of a specific second digit being required												
			<ul> <li>Followed by any sequence containing an odd number of 1s and zero or more 0s;</li> <li>A String with an odd number of 1s in it.</li> <li>A Numbers or bit patterns in place of 0s and 1s.</li> </ul>											2	

5	(a)	Reverse Polish NotationEquivalent Infix Expression456 $45+6$ $R6+45$ $R6+45$	
		$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	
		<ul> <li>1 mark per correct expression</li> <li>A extra brackets around complete expressions</li> </ul>	2
5	(b)	Simpler for a <u>machine/computer</u> to evaluate // simpler to code algorithm <b>A</b> easier <b>R</b> to understand Do not need brackets (to show correct order of evaluation/calculation); Operators appear in the order required for computation; No need for order of precedence of operators; No need to backtrack when evaluating; <b>A</b> RPN expressions cannot be ambiguous as <b>BOD</b>	1

5	(c)											
-	(-)		String	Token	Integer	0p1	0р2	Result	Stack			
			Pos		Val	•F-	•F-					
			0	-	-	-	-	-				
			1	6	6				6			
			2	4	4				46			
			3	+		6	4	10	10			
			4	3	3				3 10			
			5	2	2				2 3 10			
			6	+		3	2	5	5 10			
			7	*		10	5	50	_ 50 _			
		(	Output : <b>50</b>									
		1	<ul> <li>1 mark for each of rows 1-3</li> <li>1 mark for rows 4 and 5 together</li> <li>1 mark for rows 6 and 7 together</li> <li>1 mark for correct final output</li> <li>Values of Op1 and Op2 MUST be assigned in rows 3, 6 and 7 to</li> </ul>									
			incorrectly e	entered pre	evious values							
			l values in e	mpty cells	, even if they	are inc	orrect.			6		
5	(d)		If StackA	rray is	full							
			Then Stack Full Error									
			Else									
			Incre	ment Top	pOfStackPo	inter						
			Stack	Array [	FopOfStack	Point	er] 🗲					
			ANumber									
			EndIf									
			<b>1 mark</b> for appropriate If structure including condition (does not need									
			both Then and Else) – Do not award this mark if ANumber									
			is	<b>put into</b> St	cackArray <b>C</b>	outside	the If.					
			I mark for r	eporting e	rror in correct	place						
			I mark* for	incrementi	ing TopOfSt	ackPo	inter					
		1 mark* for storing value in ANumber into correct position in array										

<pre>* = if the store instruction is given before the increment instruction OR     the If structure then award MAX 1 of these two marks UNLESS     the item is inserted at position TopOfStackPointer+1 so the</pre>	
code would work.	
A TopOfStackPointer=20 / >=20 for Stack is full	
A Logic of If structure reversed i.e. If stack is not full / TopOfStackPointer<20/<>20/ !=20 and Then, Else swapped	
<ul><li>A Any type of brackets or reasonable notation for the array index</li><li>DPT If candidate has used a different name any variable then do not</li></ul>	
award first mark but award subsequent marks as if correct name used.	
Refer answers where candidate has used a loop to find position to insert item into stack to team leaders.	4
	<ul> <li>* = if the store instruction is given before the increment instruction OR the If structure then award MAX 1 of these two marks UNLESS the item is inserted at position TopOfStackPointer+1 so the code would work.</li> <li>I initialisation of TopOfStackPointer to 0</li> <li>A TopOfStackPointer=20 / &gt;=20 for Stack is full</li> <li>A Logic of If structure reversed i.e. If stack is not full / TopOfStackPointer&lt;20 / &lt;&gt;20 / !=20 and Then, Else swapped</li> <li>A Any type of brackets or reasonable notation for the array index DPT If candidate has used a different name any variable then do not award first mark but award subsequent marks as if correct name used.</li> <li>Refer answers where candidate has used a loop to find position to insert item into stack to team leaders.</li> </ul>

6	(a)		An abstraction / leaving out non-essential details // A mathematical representation of reality;	1
6	(b)	(i)	<ol> <li>mark for naming or describing two pointers from this list:         <ul> <li>Front/start/head pointer</li> <li>Next node pointer</li> <li>Previous node pointer</li> <li>Rear/end/tail pointer</li> <li>Rear/end/tail pointer</li> </ul> </li> <li>1 mark for stating the purpose of one of the pointers that have been named:         <ul> <li>(Front/start/head pointer) to indicate where to remove items from // who should be served next // who is currently being served; NE to points to start of list</li> <li>(Next node pointer) to link items in list together // to show order of list // so items can be inserted into middle of list // to traverse list;</li> <li>(Previous node pointer) to link items in list together // to show order of list // so items can be inserted into middle of list // to traverse list backwards;</li> <li>(Read/end/tail pointer) to indicate where to add new items to // so new people can be added to queue NE to point to end of list</li> </ul> </li> <li>A Contextualised answers which refer to queue instead of list or adding people to a queue.</li> <li>R Answers which clearly relate to the use of a fixed-size array</li> </ol>	2
6	(b)	(ii)	Priority (queue);	1
6	(c)		Allow any reasonable example that would require randomness e.g. time next person joins queue, inter-person arrival time, time to be served, choice of meal, type (student/teacher) of next person to arrive; <b>R</b> number of students/teachers/people in queue	1

7	(a)	<ul> <li>Only one (type of) product per order // Must make new order for each (type of) product;</li> <li>as ProductNumber / product details stored in relation that has OrderNumber as primary key / product relation directly related to order relation // as relations not (fully) normalised;</li> <li>Difficult to query // requires (unnecessarily) complex queries; as contains repeating groups (of attributes); A either way round</li> <li>A table for relation</li> </ul>	Max 2
7	(b)	Customer Product Order Order	
		<b>1 mark</b> for each correct relationship, up to <b>MAX 3</b> <b>MAX 2</b> if more than three relationships drawn.	Max 3
7	(c)	ProductNumber INTEGER PRIMARY KEY         //         ProductNumber INTEGER         PRIMARY KEY(ProductNumber)         }         ProductPrice SMALLMONEY         ProductDescription VARCHAR(50)         QuantityInStock INTEGER         1 mark for ProductNumber correct with appropriate type and identified as primary key         1 mark for two other fields correct with appropriate types OR 2 marks for all three other fields correct with appropriate types         A any sensible types / field lengths. eg:         For ProductNumber. integer, numeric, char, varchar, text, nchar, nvarchar, ntext, longvarchar, varchar2, nvarchar2         For ProductPrice: smallmoney, money, currency, float, real, decimal, dec, double, double precision, numeric         For ProductDescription: varchar, char, varchar, text, nchar, nvarchar, ntext, longvarchar, varchar2, nvarchar2         For QuantityInStock: integer, numeric, float, real, decimal, dec, double, double precision, numeric         For QuantityInStock: integer, numeric, float, real, decimal, dec, double, double precision, numeric         A insertion of other unnecessary but valid SQL commands e.g. AUTO INCREMENT, NOT NULL         I Spaces inserted into fieldnames e.g. Product Number	
		MAX 2 if additional fields added	3

(d)		Sequence of instructions / program / code; <b>NE</b> programming language <b>Note:</b> Do not award mark for program if candidate clearly means HTML which is executed/run/interpreted on the server (instead of the client); executed/run/interpreted when a web page is requested; to generate a web page (and its contents) which the server returns to the client // generating of dynamic web pages;	Max 2
(e)	0	<ul> <li>MAX 1 point from this list:</li> <li>Retrieve ProductNumber and Quantity // retrieve values input by user; stores values in variables;</li> <li>R responses that suggest these two commands are making the user input the values</li> <li>MAX 1 point from this list: from the web page/web site/form/web serve/bowser; using POST/GET methods;</li> </ul>	Max 2
(e)	(ii)	Query/retrieve data from the products table; to retrieve the <u>price of product</u> being ordered/selected on form/product that has correct product number/product number in ProdNum; Store the set of records/data/price returned in ProdDetails;	Max 2
(e)	(iii)	To send/output the Total Price back to the web server/web browser/client; A display price on web page R sent to user/customer	1
(f)		EITHER	
		SELECT ProductNumber, ProductDescription, ProductPrice, Quantity FROM Product, OrderLine WHERE OrderNumber = 4013 AND Product.ProductNumber = OrderLine.ProductNumber ORDER BY ProductNumber ASC 1 mark for SELECT clause with correct four fields 1 mark for FROM clause with correct two tables 1 mark for OrderNumber = 4013 1 mark for clause linking tables on the common field with no additional unnecessary clauses added 1 mark for ORDER BY ProductNumber, ASC is optional OR SELECT ProductNumber, ProductDescription, ProductPrice, Quantity FROM Product INNERJOIN OrderLine ON Product.ProductNumber = OrderLine.ProductNumber WHERE OrderNumber = 4013 ORDER BY ProductNumber ASC 1 mark for SELECT clause with correct four fields 1 mark for SELECT clause with correct four fields 1 mark for INNERJOIN together with ON Product.ProductNumber = OrderLine.ProductNumber and no other joins 1 mark for Carehumber = 07derLine.ProductNumber and no other joins	
	(d) (e) (e) (f)	(d) (e) (i) (e) (ii) (f) (f)	<ul> <li>(d) Sequence or instructions / program / code; NE programming language Note: Do not award mark for program if candidate clearly means HTML.</li> <li>which is executed/run/interpreted on the server (instead of the client); executed/run/interpreted when a web page is requested; to generate a web page (and its contents) which the server returns to the client // generating of dynamic web pages;</li> <li>(e) (i) MAX 1 point from this list: Retrieve ProductNumber and Quantity // retrieve values input by user; stores values in variables; R responses that suggest these two commands are making the user input the values</li> <li>MAX 1 point from this list: from the web page/web site/form/web serve/bowser; using POSTIGET methods;</li> <li>(e) (ii) Query/retrieve data from the product table; to retrieve the <u>price of product</u> being ordered/selected on form/product that has correct product number/product number in ProdNum; Store the set of records/data/price returned in ProdDetails;</li> <li>(f) To send/output the Total Price back to the web server/web browser/client; A display price on web page R sent to user/customer</li> <li>(f)EITHER SELECT ProductNumber, ProductDescription, ProductPrice, Quantity</li> <li>FROM Product, OrderLine WHERE OrderNumber = 4013 AND Product, ProductNumber = OrderLine.ProductNumber ORDER BY ProductNumber ASC</li> <li>1 mark for SELECT clause with correct four fields 1 mark for OrderNumber = 4013</li> <li>1 mark for Clause linking tables on the common field with no additional unnecessary clauses added</li> <li>1 mark for Clause With correct four fields</li> <li>1 mark for SELECT ProductNumber = OrderLine.ProductNumber WHER OrderNumber = 4013</li> <li>1 mark for SELECT ProductNumber ASC</li> <li>1 mark for SELECT clause with correct four fields</li> <li>1 mark for Clause With correct four fields</li> <li>1 mark for SELECT clause with correct four fields</li> <li>1 mark for SELECT clause with correct four fields</li> <li>1 mark for ORDER BY ProductNumber = OrderLine.ProductNumber WH</li></ul>

1 mark for ORDER BY ProductNumber, ASC is optional	
In both solutions: Do not award mark for SELECT clause if extra attributes listed. Do not award mark for FROM clause if extra tables listed. Do not award mark for ORDER BY clause if order descending. Only award two marks for conditions if they are connected by AND. Otherwise just award one of the marks. If candidate appears to have written two queries e.g. there are two SELECT commands then mark the first query. A table names before fieldnames. i.e. TableName.FieldName A " or ' as delimiters for 4013 A ascending, (ASC) for ASC R if ASC written before ProductNumber in ORDER BY I Spaces inserted into fieldnames e.g. Product Number	
<ul> <li>Accept answers that candidates have surrounded by "ExecuteSQL()".</li> <li>If any of the errors listed below are made, they should result in at most one mark being lost. If the mistake is made more than once then on subsequent occasions, providing that the meaning is clear, the mistake should be ignored:</li> <li>the addition of unnecessary punctuation such as semicolons the fieldname being written before the tablename</li> </ul>	5

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
8	(c)		<ul> <li>Reason: To reduce (network) congestion//improve throughput//to cut the number of collisions*; A faster operation/transmission;</li> <li>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;</li> <li>Note: * = Do not award two marks for cutting the number of collisions – only award one for either reason or explanation.</li> <li>Reason: To improve security;</li> <li>Explanation: by localising packet transmission to one segment;</li> <li>Reason: To improve reliability;</li> <li>Explanation: By limiting effect of cable failure to one segment;</li> <li>Award marks for either:     <ul> <li>one reason + explanation</li> <li>two reasons</li> <li>two explanations</li> </ul> </li> </ul>	Max 2
8	(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

8	(d) (e)	(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         Below are some example security threats and measures, but they are         only examples. Award marks for all reasonable security threats and		
			appropriate meas	ures.	
			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 <b>A</b>	
			Troian	A malicious program hidden inside another	
			nojan	program // masguerading as another program	
			Phishing	Attempts to get users to divulge personal	
			5	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	Repeated requests/pings from the Internet could	
			Service Attack	overwhelm (parts of) the network.	
			Threats must be Measures: Use a secure oper Regularly install secures Use virus checking Keep virus definiti Use anti-spyware Use of firewall to de explanation of how Use of spam filter Enable web brows Restrictions on wh White lists/black list Enforce strong pa Encryption of data Authentication of the certificate//smart of Log files Network manager manager trains us	described not simply named. rating system ecurity patches/upgrades for software g software + some explanation of what this will do ons up to date software + some explanation of what this will do control traffic between private network and Internet // v firewall might work in email package ser features to detect Pharming hich websites users can visit sts sswords d during transmission user/computer attempting remote login using digital card//security code generating device keeps informed about latest threats // network ers about threats be appropriate to security issues described.	
			More than one m	easure can be used for the same threat.	

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 language
	criteria (QLx).
	SUB Candidate has described 2 security threats and 3
	appropriate measures. To get 6 marks answer must
	include 3 threats and 3 appropriate measures
	<i>QL1</i> 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
	OL5 Appropriate specialist vocabulary has been used
L	
3-4	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 has described at least 2 security threats
	and described 1 or more appropriate security
	described) some security threats and has described 3
	or more security measures
	<i>QL1</i> 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
	OIA The candidate has used well-linked sentences and
	paragraphs.
	<i>QL5</i> Appropriate specialist vocabulary has been used.
1-2	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
	inay or may not have described some appropriate
1	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.
	connected or hullet points may have been used
	QL5 Specialist vocabulary has been used
	inappropriately or not at all.
1	

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

9	(a)	(i)	One or more a's followed by (a/one) b:	
	``	.,	A answers by example but must be at least ab, aab, aaab and show	
			that the acquence continues	4
			inal the sequence continues.	
9	(a)	(ii)	The strings ab or b // zero or one a's followed by (a/one) b	1
	. ,	. ,	<b>.</b>	
9	(a)	(iii)	A sequence of 0 or more occurrences of ab.	
	• • •	• •	A answers by example but must be at least the empty string, ab, abab,	
			ababab and show that the sequence continues	1
			ababab and show that the sequence continues.	•
9	(b)	(i)	Clai?re // Clare Claire	
			A other valid possibilities e.g. Cla(ir r)e, Cl(air ar)e	
			A use of different types of brackets	1
				-
9	(b)	(ii)	10(0 1)*01	
-	(-)	( )	<b>1 mark</b> for the 10 at the start and 01 at the end	
			<b>1 mark</b> for (0(1)* in the middle to produce a correct expression	
			<b>I mark</b> for (0[1) in the middle to produce a correct expression	
			A use of different types of brackets	
			Award <b>2 marks</b> for any other expression that would work	2

10	(a)		Number of signal changes per second // rate at which signals can change; <b>A</b> voltage changes for signal changes as BOD					
10	(b)	(i)	Each signal level/signal change represents two bits (of data)/more than one bit (of data) // channel supports four/more than two different signal levels/voltages // use of modulation/coding technique e.g. phase modulation <b>NE</b> Send more than one bit at a time <b>Must be clear that there are more than two signal levels</b>					
10	(b)	(ii)	Step	Data/Request Sent				
			2	Printer indicates ready; <b>A</b> Yes, Ack				
			3	[Computer sends] data;				
			6	Printer indicates ready to receive further data; <b>R</b> job complete <b>NE</b> data received				
			1 mark per correct step					
10	(c)		Baseband – whole bandwidth of medium dedicated to 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.					
			Suitable for LAN – lower cost electronic components (accept examples) // simpler hardware // good performance at low cost					

1		1		
NE ch	eaper			
Broad	band – bandwidth of medium shared so multiple channels			
can be	can be carried simultaneously // many computers can send data			
Carro	can be carried simulateously // many computers can send data			
simult	aneously // frequency bands assigned to different			
comm	communications. <b>TO</b> multiple wires			
Cuitak				
Sullar	ne for wan – expensive to install/maintain			
comm	unications media over long distance // many more			
device	es/people needs to communicate // more cost effective to			
abara				
snare	medium.			
How t	o award marks:			
Mark	Rands and Description			
	To aphique a mark in this hand, condidates must most			
5-4				
	the subject criterion (SUB) and 5 of the 5 quality of			
	language criteria (QLx).			
	SUB Candidate has described both baseband and			
	broadband and bac explained accurately why at			
	bioaubanu anu nas explaineu acculately why at			
	least one of these is appropriate to the context.			
	<i>QL1</i> Text is legible.			
	QL2 There are few, if any, errors of spelling,			
	punctuation and grammar. Meaning is clear			
	O/2 The condidate has calcuted and used a form and			
	QLS 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			
	OIE Appropriate apprication to constrain the base used			
	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 both broadband and			
	baseband but may not have explained why they			
	are suitable			
	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			
	accasional lanses. The candidate has expressed			
	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.			
1	To achieve a mark in this band, candidates must meet			
	the subject criterion (SLIB). The quality of language			
	should be traified by the OLy statements			
	Should be typined by the QLX statements.			
	SUB Candidate has only described one of baseband or			
	broadband.			
	QL1 Most of the text is legible.			
	QL2 There may be some errors of spelling.			
	punctuation and grammar but it should still be			
		<u>i</u>		

			QL3 QL4 QL5	possible to understand most of the response. The candidate has used a form and style of writing which has many deficiencies. Ideas are not always clearly expressed. Sentences and paragraphs may not always be well-connected or bullet points may have been used. Specialist vocabulary has been used inappropriately or not at all	
		0	Condi	date has made no relevant points	
		0	Canu	date has made no relevant points.	
		Note: for the questi	Even if points on.	English is perfect, candidates can only get marks made at the top of the mark scheme for this	
If a candidate meets the subject criterion in a band but does no 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			4		
			31105.		-



11	(b)	Deletes two ones from the (right hand) end of the string // Subtracts two from a (unary) number; A bits for ones B and of tape for end of string	
		NE deletes two ones	1
11	(c)	A Turing machine that can execute/simulate the behaviour of any other Turing machine // can compute any computable sequence; Faithfully executes operations on the data precisely as the simulated TM does; (Note: Must have idea of same process) Description of/Instructions for TM (and the TM's input) are stored on the (Universal Turing machine's) tape // The UTM acts as an interpreter; <b>A</b> take any other TM and data as input <i>Alternative definition:</i> A UTM, U, is an interpreter that reads the description <m> of any arbitrary Turing machine M; and faithfully executes operations on data D precisely as M does.; The description <m> is written at the beginning of the tape, followed by D.;</m></m>	Max 2

UMS conversion calculator www.aqa.org.uk/umsconversion