

## A-level COMPUTER SCIENCE

Paper 2 Additional Questions

## IMPORTANT NOTES

These questions focus primarily on topics that were not covered by the AQA AS and A-level Computing specifications, introduced in 2009. It is hoped that teachers will find questions on these new topics to be particularly useful.

Many example questions on topics that are common to the new and old specifications can be found on past papers for COMP1, 2 and 3 on our website. Past papers that are more than three years old can be accessed via e-AQA.

This document contains additional questions; it is not intended to be treated as a complete paper. The questions do not provide balance coverage of the specification or the assessment objectives in the same way that a fully live paper would do.

Version 2.1 15/02/2015

		Ansv	ver <b>all</b> questio	ns in the space	es provided.		
F to A	or each ro indicate v s an exam nember of	which set(s) of nple, the first ro the set of irrati	shade <b>one or</b> numbers the i ow has been co ional numbers	more lozenges number on the ompleted for yo	s, in the appropri row is a membe ou, to indicate th real numbers, b	er of. $at \sqrt{2}$ is a	s),
·				Table 1		[3 ma	rks]
	[	Natural	Integer	Rational	Irrational	Real	
	$\sqrt{2}$	0	0	0	•	•	
	-64	0	0	0	0	0	
	10	0	0	0	0	0	
	5/128	$\circ$	0	$\circ$		$\bigcirc$	
0 1 . 2 E	Apidin the	purpose of ord	and nambers.			[1 m	ark]
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0 2 . 1	A computer represents numbers using <b>8-bit two's complement</b> binary.	
	Using this representation, perform the decimal calculation $78_{10} - 23_{10}$ .	
	Show all of your working.	
		[3 marks]
0 2 . 2	Perform the binary calculation 1011 <sub>2</sub> * 101 <sub>2</sub> .	
<u>v -</u>  - -		
	Show all of your working.	[2 marks]

0 3	The following value is stored in a byte:
	1 0 1 1 0 0 1
0 3 . 1	If the byte represents <b>an unsigned binary integer</b> , what is its value in <b>decimal</b> ? [1 mark]
0 3 . 2	If the byte represents <b>a two's complement binary integer</b> , what is its value in <b>decimal</b> ?  [1 mark]
03.3	If the byte represents an <b>unsigned fixed point binary number</b> with five bits to the left of the decimal point and three bits to the right of it, what is its value in <b>decimal?</b> [1 mark]
0 3 . 4	If the byte represents an <b>unsigned binary integer</b> , what is its value in <b>hexadecimal</b> ?  [1 mark]
0 3 . 5	Explain why programmers often prefer to write numbers in hexadecimal instead of binary.  [1 mark]

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0 3 . 6	If the byte represents an ASCII character that has been received during a transmission, with the most significant (leftmost) bit being used as a parity bit and the odd parity system in use, explain whether or not the character has been received correctly and how you have determined this.  [2 marks]
0 3 . 7	State <b>two</b> reasons why the Unicode character coding system was introduced as an alternative to ASCII.  [2 marks]
	Reason 1
	Reason 2

0 4	Figure 1 shows two alternative architectures for computer systems.				
	Figure 1	Amalaita atauna A	<b>A</b>	abita stana D	
		Architecture A	Ar	chitecture B	
		Instruction		Memory	
		Memory		·	
					1
		Processor		Processor	
					1
		Data Memory			
0 4 . 1		of <b>Architecture A</b> of <b>e</b> lozenge below.	or Architecture	<b>B</b> is the Harva	rd architecture by
					[1 mark]
	Harvard archi	tecture is: Arc	chitecture A	Archit	ecture B
0 4 . 2		situation that the Ha			
	advantages tr	ne Harvard architectu	are has over th	e von Neumann	[3 marks]
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0 4 . 3 Figure 2 shows the fetch-execute cycle, excluding how interrupts are dealt with. Some of the steps in the cycle have been described. Describe the missing steps 1, 2b and 4 using either register transfer notation or a written description. Steps 2a and 2b occur at the same time. [3 marks] Figure 2 Step 1 1 **Step 2a** PC ← [PC] + 1 (Increment contents of Program Counter Register) 2 Step 2b Step 3: CIR ← [MBR] 3 (Transfer contents of Memory Buffer Register into Current Instruction Register) Step 4 4 5 Step 5 **Execute Instruction** 

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0 4 . 4	An interrupt can occur during the fetch-execute cycle.	
	Explain what happens when an interrupt occurs.	[4 marks]

0 5	<b>Figure 3</b> shows the physical topology of a typical home Local Area Network (LAN) and its connection to the Internet. The LAN uses the IPv4 protocol.			
	Figure 3			
	Router Switch Combined Device			
	Device A is a Wireless Access Point. A range of devices, including laptop computers and mobile phones connect to the network through the Wireless Access Point.  Device B is a Network Attached Storage device which is a server used to store files			
0 5 . 1	that can be accessed by other devices connected to the network.  The devices that are used within the home have private IP addresses. The combined			
	device has both a private IP address and a public IP address.			
	Explain the differences between private and public IP addresses, and why the Combined Device has both.  [3 marks]			

0 5 . 2	The Combined Device performs Network Address Translation (NAT) when a device in the home communicates with a host on the Internet.
	Explain what NAT is and why it is performed.  [3 marks]
0 5 . 3	When purchasing the storage devices to use in the Network Attached Storage device, a choice had to be made between buying Solid State Drives (SSDs) and traditional hard disk drives.
	Discuss the merits of each of these two types of storage device for this application.  [3 marks]

0 5 . 4	Describe the principles of operation of a Solid State Drive (SSD).	[4 marks]
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0 6	A dynamic web page allows users to search for books in a library so that their details can be viewed online.			
	The web page uses the Websocket protocol and is able to update the list of books found by a query without having to reload the entire page.			
	The details of the books that the library owns, library members and loans are stored using the three relations in <b>Figure 4</b> .			
	Figure 4			
	Book (BookID, Title, Author, Price, Category, Publisher)			
	Member (MemberID, Forename, Surname, MaxBooks, DateOfBirth)			
	Loan (LoanID, BookID, MemberID, DateLoaned, Returned)			
0 6 . 1	Write the SQL instructions that are required to create the Member table.  [3 marks]			
	CREATE TABLE Member (			
0 6 . 2	Write an SQL query to retrieve the BookID, Title, Author, Price and Category of all books written by "David Ferguson" that cost less than £25.00. The books should be listed in order, with the most expensive book at the top of the list and the cheapest at the bottom.  [4 marks]			
	[4 marks			

0 6 . 3 Which of the four functions of CRUD would the query that you have written in part 0 6 . 2 map to? [1 mark]

The SQL query from part 0 6 . 2 is executed on the server and finds the following two records:

BookID	Title	Author	Price	Category
10324	The life of a tiger	David Ferguson	19.50	Wildlife
16294	Living with lions	David Ferguson	12.99	Wildlife

These records could be sent from the server to the client using XML or JSON.

**Figure 5** shows the query results encoded using each of these methods.

Figure 5

Representation 1	Representation 2
{"Books":[	<books></books>
{ "BookID": 10324, "Title": "The life of a tiger", "Author": "David Ferguson", "Price": 19.50, "Category": "Wildlife" }, { "BookID": 16294, "Title": "Living with lions", "Author": "David Ferguson", "Price": 12.99, "Category": "Wildlife" }	<pre> <book></book></pre>

0 6 . 4 Identify which of Representation 1 or Representation 2 is encoded using JSON by shading in one lozenge below.

[1 mark]

JSON is: Representation 1 Representation 2

**0 6 . 5** State **two** advantages of JSON over XML:

Advantage 1

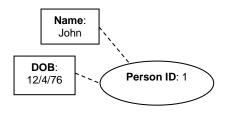
[2 marks]

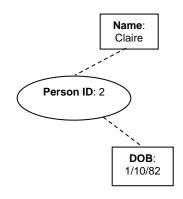
Advantage 2

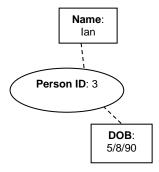
0 7	One characteristic of a data set that might result in it being classified as Big Data is that it contains a very large volume of data.
0 7 . 1	Describe <b>two</b> other characteristics that might also result in a data set being classified as Big Data.
	[2 marks]
	Characteristic 1
	Characteristic 2
0 7 . 2	Big data is usually processed using parallel or distributed computer architectures.
	Explain why functional programming is one appropriate method to use when this is the case.
	[2 marks]

0 7 . 3 Big Data can be represented using graph schema. Figure 6 shows part of a graph schema for employees of a company.

Figure 6







Complete the graph schema to represent the following facts:

- a) John and Ian both work for the Finance department.
- b) Claire works for the HR department.
- c) Ian is John's manager.
- d) John also has the extra role of First Aider.
- e) Ian and Claire are married.

[3 marks]

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0 8 . 1	${\tt MOD}(x,y)$ computes the reminder when $x$ is divided by $y$ . For example, ${\tt MOD}(13,3)=1$ since 13 divided by 3 is 4 remainder 1. What is the co-domain of the ${\tt MOD}$ function?
	Two functions have been defined:
	DOUBLE $(x) = 2 * x$ SQUARE $(x) = x * x$
08.2	State the result of evaluating SQUARE ODOUBLE (3).
	[1 mark]
08.3	Explain the purpose of the REDUCE or FOLD function in a functional programming language.
	[2 marks]

The MOD function calculates the remainder after an integer division has been carried

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out.

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0 9	A group of developers are setting up a cloud storage system that will allow Internet users worldwide to store their files on servers and share them with other users.
	Discuss the ethical, legal and cultural issues that the developers will face when setting up and running the service.
	up and running the service. [9 marks]

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Wheel settings to use  Plaintext: CROCODILE  Ciphertext: ODAOAPUXQ  Decrypt the ciphertext "QXQBTMZF" using the Caesar cipher with the setting in Figure 7.  Using the Vernam cipher method, the plaintext "RUN" is to be encrypted. "Rencoded using 8-bit ASCII, according to the ASCII table in Figure 8.  Figure 8  Letter ASCII Code Letter ASCII Code Letter ASCII Code A 01000001 J 01001010 S 01010011 B 01000010 K 01001011 T 01010100 C 0100011 L 01001100 U 01010101 D 01000100 M 01001101 V 01010101 D 01000100 M 01001111 V 01010111 E 01000101 N 01001111 W 01010111 F 01000101 O 01001111 X 01011000 G 01001111 P 01010000 Y 01011001 H 01001000 Q 01010001 Z 01011010 I 01001010 I 01001010 I 01001010 I 01001000 I 2 01011010 I 01001000 I 2 01011010 I 01001000 I 2 01011010	Figure 7	' shows a messag	ge being e	ncrypted using a	Caesar c	ipher.
Plaintext: CROCODILE Ciphertext: ODAOAPUXQ  Decrypt the ciphertext "QXQBTMZF" using the Caesar cipher with the setting in Figure 7.  Using the Vernam cipher method, the plaintext "RUN" is to be encrypted. "Rencoded using 8-bit ASCII, according to the ASCII table in Figure 8.  Figure 8  Letter ASCII Code Letter ASCII Code Letter ASCII Code A 01000001 J 01001010 S 01010011 B 01000010 K 01001011 T 01010100 C 01000110 L 01001100 U 01010101 D 01000100 M 01001101 V 010101010 E 01000101 N 01001110 W 01010111 F 01000110 O 01001111 X 01011000 G 01000111 P 01010000 Y 01011001 H 01001000 Q 01011001 Z 01011010	Figure 7	,				
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E 01000101 N 01001110 W 01010111 F 01000110 O 01001111 X 01011000 G 01000111 P 01010000 Y 01011001 H 01001000 Q 01010001 Z 01011010	Figure 8  Letter A B	ASCII Code 01000001 01000010	Letter J K	ASCII Code 01001011	Letter S T	ASCII Code 01010011 01010100
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The key 10111001 01001101 01000001 will be used to perform the encryp	E F G H	ASCII Code 01000001 01000010 01000101 01000101 01000111 01000111 010010	Letter J K L M N O P Q R	ASCII Code 01001010 01001011 01001100 01001110 01001111 01010000 01010001 01010010	Letter S T U V W X Y Z	ASCII Code 01010011 01010100 01010110 01010111 01011000 01011001 01011001
The key 10111001 01001101 01000001 will be used to perform the encryp	E F G H	ASCII Code 01000001 01000010 01000101 01000101 01000111 01000111 010010	Letter J K L M N O P Q R	ASCII Code 01001010 01001011 01001100 01001110 01001111 01010000 01010001 01010010	Letter S T U V W X Y Z	ASCII Code 01010011 01010100 01010110 01010111 01011000 01011001 01011001
The key 10111001 01001101 01000001 will be used to perform the encryption, showing how you have worked out what the ciphert	E F G H I	ASCII Code 01000001 01000010 01000100 01000101 01000110 01000111 010010	Letter J K L M N O P Q R	ASCII Code 01001010 01001011 01001101 01001110 01001111 01010000 01010001 01010010	Letter S T U W X Y Z	ASCII Code 01010011 01010100 01010110 01010111 01011000 01011001 01011001
	E F G H I The key	ASCII Code 01000001 01000010 01000101 01000101 01000111 01000111 010010	Letter J K L M N O P Q R	ASCII Code 01001010 01001011 01001101 01001110 01001111 01010000 01010001 01010010	Letter S T U W X Y Z	ASCII Code 01010011 01010100 01010110 01010111 01011000 01011001 01011001
Perform this encryption, showing how you have worked out what the ciphert	E F G H I The key	ASCII Code 01000001 01000010 01000101 01000101 01000111 01000111 010010	Letter J K L M N O P Q R	ASCII Code 01001010 01001011 01001101 01001110 01001111 01010000 01010001 01010010	Letter S T U W X Y Z	ASCII Code 01010011 01010100 01010110 01010111 01011000 01011001 01011001
Perform this encryption, showing how you have worked out what the ciphert	E F G H I The key	ASCII Code 01000001 01000010 01000101 01000101 01000111 01000111 010010	Letter J K L M N O P Q R	ASCII Code 01001010 01001011 01001101 01001110 01001111 01010000 01010001 01010010	Letter S T U W X Y Z	ASCII Code 01010011 01010100 01010110 01010111 01011000 01011001 01011001
Perform this encryption, showing how you have worked out what the ciphert	E F G H I The key	ASCII Code 01000001 01000010 01000101 01000101 01000111 01000111 010010	Letter J K L M N O P Q R	ASCII Code 01001010 01001011 01001101 01001110 01001111 01010000 01010001 01010010	Letter S T U W X Y Z	ASCII Code 01010011 01010100 01010110 01010111 01011000 01011001 01011001

1	0 .	3	Explain why messages encrypted using a Caesar cipher can be easily cracked, and why the Vernam cipher is, under certain conditions, considered to be perfectly secure.  [4 marks]
			[4 marks]
			-

1 1	The triangle in <b>Figure 9</b> is repesented as part of an image using vector graphics.
	Figure 9
	(0,0)
11.1	The location of the triangle on the screen is represented by storing the co-ordinates of its three corners.
	State <b>two</b> distinct properties, other than the co-ordinates, that could be stored about a
	triangle object. [2 marks]
	Property 1
	Property 2
1 1 . 2	Discuss the advantages and limitations of vector graphics when compared to the use of bitmap graphics.  [3 marks]

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