



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.

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Answer **all** questions in the spaces provided.

0 1 . **1** Four numbers are listed in the rows of **Table 1**.

For each row in **Table 1**, shade **one or more** lozenges, in the appropriate column(s), to indicate which set(s) of numbers the number on the row is a member of.

As an example, the first row has been completed for you, to indicate that $\sqrt{2}$ is a member of the set of irrational numbers **and** the set of real numbers, but is **not** a member of the sets of natural, integer or rational numbers.

[3 marks]

Table 1

	Natural	Integer	Rational	Irrational	Real
$\sqrt{2}$	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
-64	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5/128	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

0 1 . **2** Explain the purpose of ordinal numbers.

[1 mark]

0 2 .

1

A computer represents numbers using **8-bit two's complement** 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 $1011_2 * 101_2$.

Show all of your working.

[2 marks]

5

0 3

The following value is stored in a byte:

1 0 1 1 0 0 0 1

0 3

. 1

If the byte represents an **unsigned binary integer**, what is its value in **decimal**?

[1 mark]

0 3

. 2

If the byte represents a **two's complement binary integer**, what is its value in **decimal**?

[1 mark]

0 3

. 3

If the byte represents an **unsigned fixed point binary number** with five bits to the left of the decimal point and three bits to the right of it, what is its value in **decimal**?

[1 mark]

0 3

. 4

If the byte represents an **unsigned binary integer**, what is its value in **hexadecimal**?

[1 mark]

0 3

. 5

Explain why programmers often prefer to write numbers in hexadecimal instead of binary.

[1 mark]

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 **two** reasons why the Unicode character coding system was introduced as an alternative to ASCII.

[2 marks]

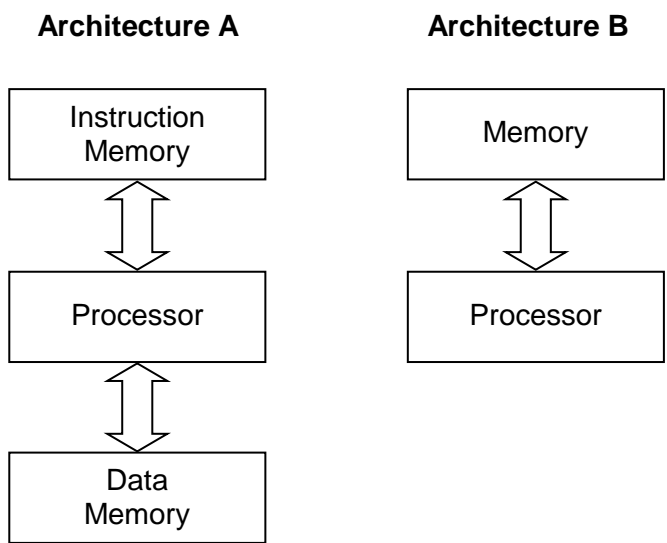
Reason 1

Reason 2

0 4

Figure 1 shows two alternative architectures for computer systems.

Figure 1



0 4 . 1

Identify which of **Architecture A** or **Architecture B** is the Harvard architecture by shading in **one** lozenge below.

[1 mark]

Harvard architecture is: **Architecture A** **Architecture B**

0 4 . 2

Describe **one** situation that the Harvard architecture is used for, and explain what advantages the Harvard architecture has over the von Neumann architecture.

[3 marks]

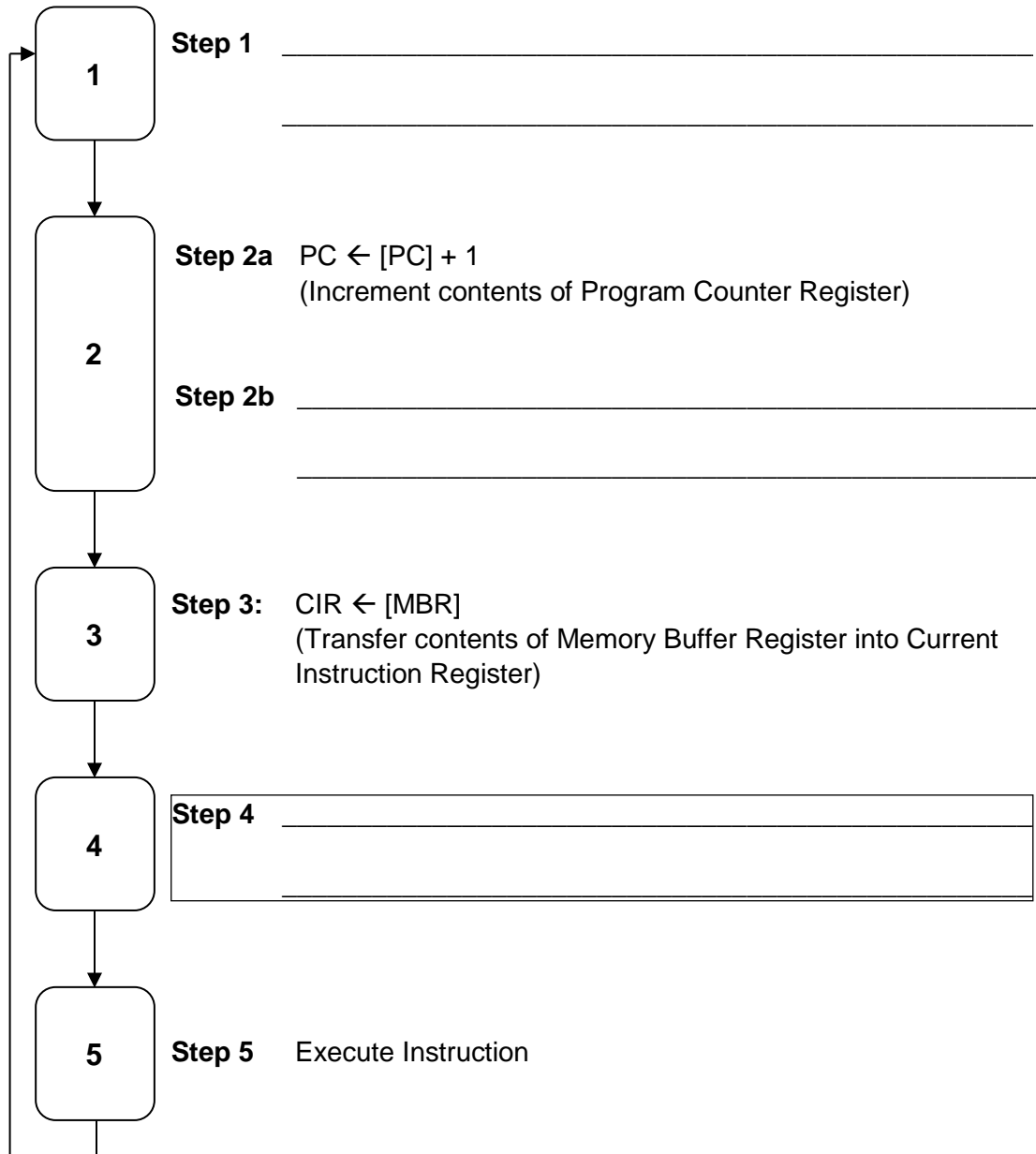
0 4 . 3

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



0 4 .

4

An interrupt can occur during the fetch-execute cycle.

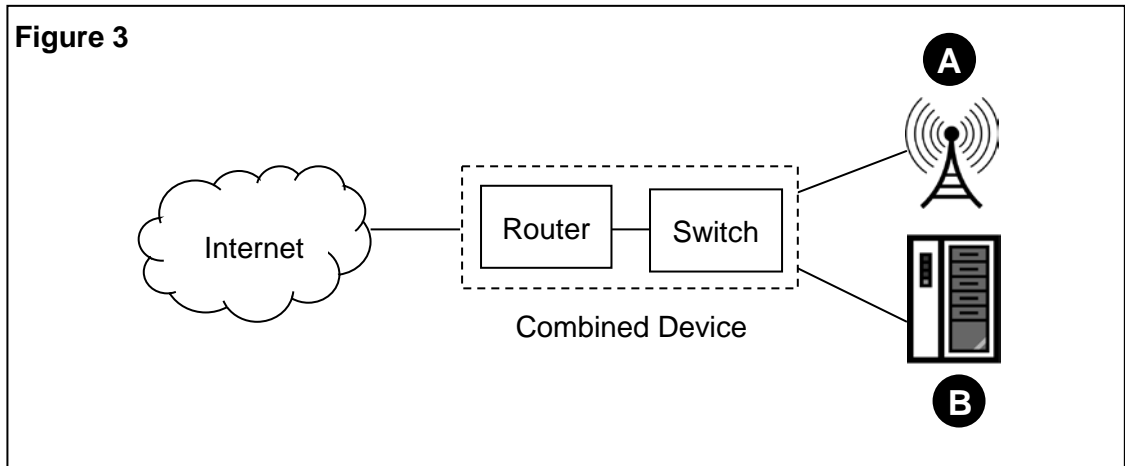
Explain what happens when an interrupt occurs.

[4 marks]

11

0 5

Figure 3 shows the physical topology of a typical home Local Area Network (LAN) and its connection to the Internet. The LAN uses the IPv4 protocol.



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 that can be accessed by other devices connected to the network.

0 5

. 1

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]

13

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 **Figure 4**.

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]

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
<pre>{ "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>	<pre><Books> <Book> <BookID>10324</BookID> <Title>The life of a tiger</Title> <Author>David Ferguson</Author> <Price>19.50</Price> <Category>Wildlife</Category> </Book> <Book> <BookID>16294</BookID> <Title>Living with lions</Title> <Author>David Ferguson</Author> <Price>12.99</Price> <Category>Wildlife</Category> </Book> </Books></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:

[2 marks]

Advantage 1

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 **two** 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.

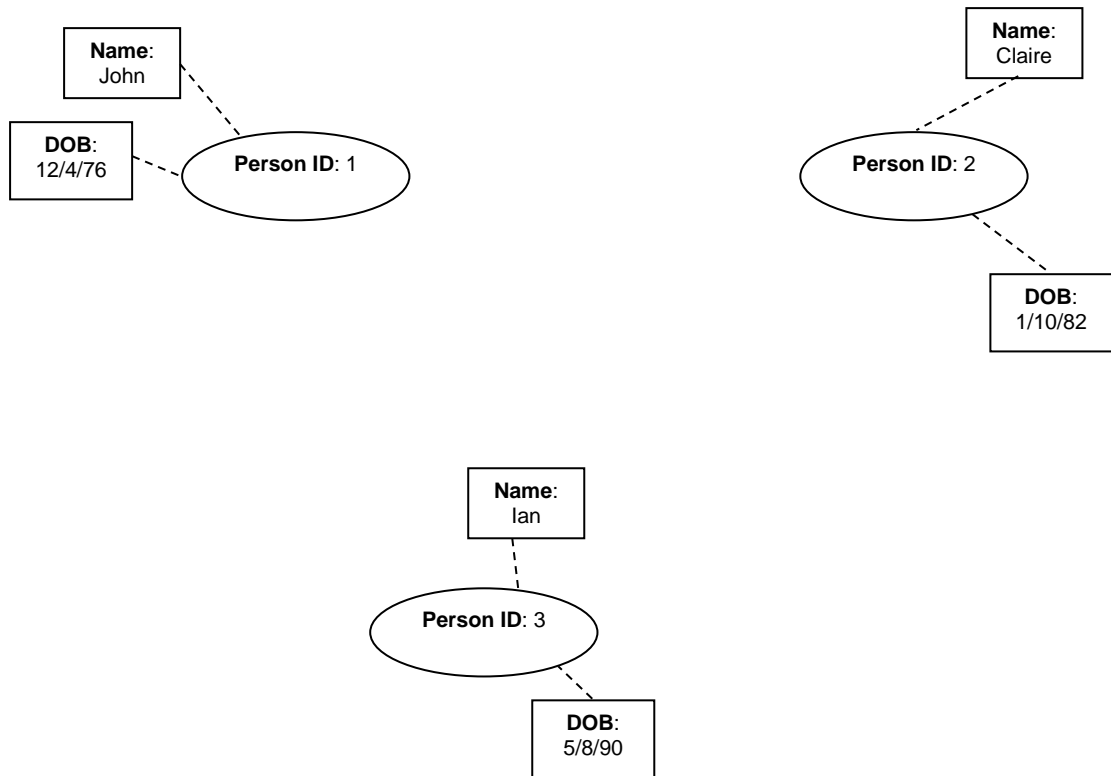
Explain why functional programming is one appropriate method to use when this is the case.

[2 marks]

07 . 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]

7

0 8

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

$\text{MOD}(x, y)$ computes the remainder when x is divided by y .

For example, $\text{MOD}(13, 3) = 1$ since 13 divided by 3 is 4 remainder 1.

0 8

. 1

What is the co-domain of the MOD function?

[1 mark]

Two functions have been defined:

$\text{DOUBLE}(x) = 2 * x$

$\text{SQUARE}(x) = x * x$

0 8

. 2

State the result of evaluating $\text{SQUARE} \circ \text{DOUBLE}(3)$.

[1 mark]

0 8

. 3

Explain the purpose of the REDUCE or FOLD function in a functional programming language.

[2 marks]

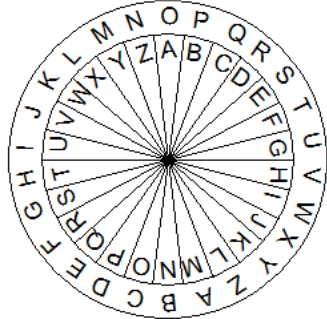
4

1 0

Figure 7 shows a message being encrypted using a Caesar cipher.

Figure 7

Wheel settings to use



<p>Plaintext: CROCODILE</p> <p style="text-align: center;">↓</p> <p>Ciphertext: ODAOAPUXQ</p>

1 0

. 1

Decrypt the ciphertext "QXQBTMZF" using the Caesar cipher with the settings shown in Figure 7.

[1 mark]

1 0

. 2

Using the Vernam cipher method, the plaintext "RUN" is to be encrypted. "RUN" will be encoded 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	01000011	L	01001100	U	01010101
D	01000100	M	01001101	V	01010110
E	01000101	N	01001110	W	01010111
F	01000110	O	01001111	X	01011000
G	01000111	P	01010000	Y	01011001
H	01001000	Q	01010001	Z	01011010
I	01001001	R	01010010		

The key 10111001 01001101 01000001 will be used to perform the encryption.

Perform this encryption, showing how you have worked out what the ciphertext would be from the plaintext.

[3 marks]

10 . 3

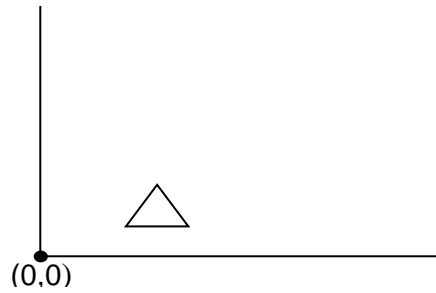
Explain why messages encrypted using a Caesar cipher can be easily cracked, and why the Vernam cipher is, under certain conditions, considered to be perfectly secure.

[4 marks]

1 1

The triangle in **Figure 9** is represented as part of an image using vector graphics.

Figure 9



1 1

. 1

The location of the triangle on the screen is represented by storing the co-ordinates of its three corners.

State **two** 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]
