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Examiners' report

COMPUTER SCIENCE

H446

For first teaching in 2015

H446/01 Summer 2022 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

Paper 1 series overview

H446/01 (Computer Systems) is one of two examined components for the GCE A Level Computer Science.

This component focuses on:

- The characteristics of contemporary processors, input, output and storage devices
- Software and software development
- Exchanging data
- Data types, data structures and algorithms
- Legal, moral, cultural and ethical issues

To do well on this paper, candidates need to be able to demonstrate and apply knowledge across all the topics listed above, in different contexts.

It is important that candidates apply their knowledge to the question where a scenario or data is provided. Extra information was provided for this series, but candidates were still expected to have covered the whole specification. Definitions were at times not clearly expressed and key terms not used. Centres should take note of the SQL that candidates are expected to have awareness of.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• Applied their knowledge to the context • Were able to write pseudocode or program code • Were able to address all parts of the question in their extended answer responses • Were able to explain the principles of ACID	• Gave unclear definitions • Attempted to answer questions with a mix of pseudocode and program code • Only addressed a part of an extended answer question

Question 1 (a) (i)

1 A charity uses a desktop computer to record financial donations that it receives. The computer contains a single core, 2.4GHz processor with 2MB cache.

(a) The processor uses the Von Neumann architecture.

(i) Describe what is meant by the term 'Von Neumann architecture'.

.....

.....

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..... **[2]**

Many candidates were able to access full marks on this question. This question has been asked in previous papers and candidates should be encouraged to use these to make sure they are clear in their responses. There were many possible responses in the mark scheme to help candidates to gain full marks. Most candidates gained at least 1 mark.

Question 1 (a) (ii)

(ii) Give **one** way that the Harvard architecture differs from the Von Neumann architecture.

.....

..... **[1]**

This question was generally answered well by candidates and the majority gave separate areas of memory for data and instructions. Where candidates were not given marks, it was generally because their answer was unclear, e.g. just saying 'separate memory'.

Question 1 (b)

(b) The charity is concerned that the performance of the computer is not sufficient and wishes to replace the processor.

Give **two** features of a replacement processor that would increase the typical performance of the computer.

1 .....

.....

2 .....

.....

[2]

Most candidates were able to gain full marks on this question. Less successful responses often mentioned clock speed, cache or cores without referring to an improvement, e.g. higher or faster.

Question 1 (c) (i)

(c) **Fig. 1** shows assembly code written using the Little Man Computer (LMC). The program calculates and outputs the total amount that is donated to the charity in any particular day. Depending on the amount, an additional bonus may be added to each amount donated.

```
start      INP
           STA donation
           SUB hundred
           BRP bonus
nobonus    LDA total
           ADD donation
           STA total
           OUT
           BRA start
bonus      LDA total
           ADD donation
           ADD twenty
           STA total
           OUT
           BRA start
hundred    DAT 100
twenty     DAT 20
donation   DAT 0
total      DAT 0
```

Fig. 1

(i) The program shown in **Fig. 1** is run **once** using **three** different inputs. Therefore, while the program is running once, it will output the updated total three times.

Give the total values that are output when the values **10**, **50** and **120** are input into this program.

Output for 10 .....

Output for 50 .....

Output for 120 .....

[3]

This was generally well answered by candidates who had a good understanding of LMC. Candidates should be encouraged to trace through LMC programs with different values as well as writing them.

Question 1 (c) (ii)

(ii) Write LMC code that will reset the value of the memory location labelled `total` to zero and then stop the program.

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..... **[4]**

This was generally answered well, and the majority of students were able to gain marks with most gaining 3 or 4 marks. Less successful responses over complicated the program leading to them making mistakes. A small number of candidates attempted to answer in pseudocode rather than LMC. Candidates should be encouraged to use the commands in Appendix 5d of the specification.

Question 1 (c) (iii)

(iii) This program is run on a processor that allows pipelining.

Define the term 'pipelining'.

.....

.....

.....

.....

.....

..... **[3]**

Many candidates were able to gain at least 2 marks on this question. Some candidates were not awarded marks as they wrote about multiple cores or programs being fetched instead, of instructions.

Exemplar 1

Pipelining is when a computer can fetch the next instruction whilst the previous is being decoded and the one before that is being executed. There is two types of pipelining: arithmetic and instruction. Pipelining allows multiple instructions to be processed at the same time. **[3]**

The candidate has clearly described pipelining with correct terminology. They gained full marks for the description of one instruction being decoded while another is fetched and another is executed, as well as describing that it allows multiple instructions to be processed at the same time.

Question 1 (c) (iv)

(iv) Explain **one** benefit to the charity of using a processor that allows pipelining.

.....

.....

.....

..... **[2]**

Many candidates gained 1 mark for giving a benefit to the charity, but they did not go on to say why pipelining enabled that. Some candidates did not apply their answer to the charity, so were not awarded the mark for the benefit.

Question 1 (d) (i)

(d) The processor contains registers including the accumulator and the program counter. The contents of these registers are modified during the Fetch-Decode-Execute cycle.

(i) Describe how the accumulator is used during the Fetch-Decode-Execute cycle.

.....

.....

.....

..... **[2]**

Most candidates were able to access 1 mark for the result of ALU calculations, but few were able to give two uses. Some confused the accumulator with the program counter and the ALU.

Question 1 (d) (ii)

(ii) Describe how the program counter is used during the Fetch-Decode-Execute cycle.

.....

.....

.....

..... **[2]**

This question was generally well answered by candidates who gave clear responses.

Misconception

Some candidates thought that the program counter kept track of a count of the number of instructions that had been fetched.

Question 1 (d) (iii)

(iii) State the name of **three** other registers that are used during the Fetch-Decode-Execute cycle.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

Most candidates gained full marks on this question and were able to correctly identify three other registers. Some lost marks for saying the ALU or control unit were registers.

Question 1 (e)*

(e)* The charity has several desktop computers in their office that use a CISC processor. They are considering buying mobile devices for their staff to use when they are not in the office.

Discuss whether these mobile devices should use the same CISC processors that are used in their desktop computers or if they should use a RISC processor instead.

You should include the following in your answer:

- the difference between each processor type
- the suitability of each processor type for mobile devices. **[12]**

Many candidates were able to discuss the difference in reduced or complex instruction sets and gave some discussion of the increase in hardware requirements for CISC. Few talked about the software differences, and some assumed the charity would need to be programming the devices which was not relevant to the question.

Question 2 (a) (ii)

(ii) Identify the foreign key used in the database and the table name where this is a foreign key.

Foreign Key .....

.....

Table Name .....

.....

[2]

Many candidates gained 1 mark for the foreign key and most gained both marks, although some candidates gave 'package' as the table where it is a primary key rather than the membership table where it is the foreign key.

Question 2 (b)

(b) The `Adverts` field indicates if customers will be shown adverts. `true` indicates that customers will be shown adverts, and `false` indicates that adverts are not shown.

Write Structured Query Language (SQL) to return the `Username` and `FirstName` fields for all customers who see adverts.

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.....

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..... **[5]**

Many candidates were able to gain some marks. The question refers to the Adverts field which is in the package table and states that the data shown in the tables is only an extract from the tables. For full marks on this question, candidates were expected to attempt to join the two tables to access the Username and Firstname from the membership table, and the Adverts from the package table.

Question 2 (c) (i)

(c) When new customers join the streaming service, their name, email address and contact details are captured so that they can be entered into the database.

(i) Identify **one** method of capturing a new customer's personal data, describing why this method is suitable.

Method .....

.....

Suitability .....

.....

.....

.....

[3]

Few candidates were able to gain full marks on this question as many overcomplicated it or could not give a relevant data capture method. When they did give form as a relevant answer, they often had unclear suitability.

Exemplar 2

Method ..... Electronic form filled out by customer. .....

Suitability ..... An electronic form can be pressed automatically and ~~details~~ new customer details automatically added to the database. An electronic form is also suitable for the customer as it can be filled in at home. .....

[3]

The candidate has given a valid method and has given clear and correct suitability by describing that the details could be automatically added to the database and can be filled in from home, which would be a remote location. The candidate gained the full 3 marks.

Question 2 (c) (ii)

(ii) Sometimes the company may need to move or backup its data they hold about customers.

Identify **two** methods of exchanging data with other computer systems.

1 .....

.....

2 .....

.....

[2]

Few candidates gained full marks on this question although there were a range of relevant responses they could have given.

Question 2 (d) (i)

(d) The database supports ACID transactions. ACID stands for Atomicity, Consistency, Isolation and Durability.

(i) Describe what is meant by a transaction being durable.

.....

.....

.....

..... **[2]**

Question 2 (d) (ii)

(ii) Give **one** way that durability can be achieved for a completed transaction.

.....

..... **[1]**

Question 2 (d) (iii)

(iii) Explain how record locking can be used to ensure that the ACID principle of isolation is achieved when carrying out multiple transactions.

.....

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.....

..... **[3]**

For candidates with a good understanding of ACID, these questions were well answered. Unfortunately, some had only a vague knowledge or confused it with referential integrity. Some answers were unclear. Some candidates talked about locking the entire database when record locking rather than just the relevant records.

Question 2 (d) (iv)

(iv) Give **one** disadvantage of using record locking.

.....

..... **[1]**

Many candidates were given a mark for deadlock or longer wait times. Those candidates given a mark in Question 2 (d) (iv) tended to be those who has gained marks in Question 2 (d) (iii).

Question 2 (e)

(e) The Copyright Designs and Patents Act 1988 applies to all videos that are streamed.

Explain how this act applies to the videos.

.....

.....

.....

..... **[2]**

Most candidates were able to gain 1 mark for this question, but few went on to gain a second mark.

Question 2 (f)

(f) All videos that are streamed are compressed. Customers have the option to choose from watching the videos with lossy compression or lossless compression.

Explain how this choice will impact the customer.

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.....

..... **[5]**

Candidates tended to write at length for this question, but often made the same point twice. Many missed marks for not making the comparison between lossy and lossless and only gave one side. Some candidates discussed the videos being downloaded rather than streamed.

Question 2 (g) (i)

(g) A program is written using an object-oriented programming paradigm and uses a class called `video` to organise the videos that are streamed to customers.

The class `video` has these attributes:

- name
- number of views
- star rating.

The constructor method will set the name attribute to the name that is passed in as a parameter. The constructor will also initially set the number of views to 0 and the star rating to 3.

(i) Write program code or pseudocode to declare the class `video` and initialise the required attributes as private.

You should include **both** the attribute definitions and the constructor method in your answer.

.....

.....

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.....

.....

..... **[7]**

This question was well answered by some candidates. The question asks for pseudocode or program code and candidates should be encouraged to do one or the other if given a choice, rather than a combination of the two. Many candidates did not use the information in the question stem to help them structure their answer and gave more than one parameter in the constructor.

Exemplar 3

```
Class Video
    private name
    private number of views
    private star rating

    public procedure new(aName)
        name = aName
        number of views = 0
        star rating = 3
    endprocedure
endclass
```

This was a good clear example of an answer given in pseudocode. The candidate has declared the 3 given attributes as private, shown a constructor with one parameter and set name to the parameter and views and rating to 0 and 3. The candidate gained 7 marks.

Question 2 (g) (ii)

(ii) A public method called `updateviews()` will update the number of views after a video has been viewed. This method is defined inside the `video` class.

Write program code or pseudocode for the method `updateviews()` to increase the number of views by one.

..... **[2]**

Most candidates were able to gain at least 1 mark for this question. Those who were not given marks used pseudocode but did not state that the procedure was public, or they did not use the same attribute they had declared in Question 2 (g) (i).

Question 3 (a) (iii)

(iii) Complete this binary subtraction. Both numbers are 8-bit integer values represented using two's complement.

Show the result in the same format and show your working.

0110 1101 –

0011 0100

.....

.....

.....

.....

.....

..... **[3]**

Most candidates were able to gain some marks, with many gaining full marks. A popular method was to do two's complement addition. Candidates should be encouraged to show their working in binary and not do the subtraction in denary and then just give the answer in binary. The question asks them to complete a binary subtraction.

Question 3 (b)

(b) The normalised floating point number 1010 1110 is stored using 4 bits for the mantissa and 4 bits for the exponent, both in two's complement.

Give the denary version of this number, showing your working.

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..... **[4]**

Most candidates correctly identified the exponent and that the point needed to be moved to the left. Any valid method of working was given marks here, where candidates got the correct answer.

Question 3 (c)

(c) **Table 3** here shows floating point numbers that are stored using 6 bits for the mantissa and 3 bits for the exponent, both in two's complement.

Tick (✓) one box in each row to state whether each number is normalised or not normalised.

Binary number	Normalised	Not normalised
010101 100		
110101 111		
011010 010		
101010 110		

Table 3

[4]

This question was mostly well answered. However, some candidates were able to identify 01 as being normalised but not 10 being normalised.

Question 4*

4* Amit is studying Computer Science at university. He has been asked to write an assignment on Artificial Intelligence (AI).

Discuss the extent to which you think computer systems will inherit the biases and discrimination of their programmers as the use of AI increases.

You should include the following in your answer:

- the meaning of AI
- examples of when AI may be affected by bias
- the measures that can be taken to prevent people being affected by bias in AI. **[9]**

There were a wide range of responses to this question and a wide range of marks given. The most successful responses were able to address all parts of the question and could give the meaning of AI as well as some relevant examples of AI bias. They were also able to give at least one measure that could be taken. Many candidates used self-driving cars as their only example and should be encouraged to explore the use of AI in different fields. Some confused the AI being biased with people being biased against AI. Many candidates were unable to give relevant measures for preventing bias. Candidates should be encouraged to make sure they include all points the question asked for, in their answer.

Question 5 (b) (i)

(b) Before the code in **Fig. 5** can be executed, a translator must be used.

(i) State the purpose of a translator.

.....

..... **[1]**

This question was generally well answered, though some candidates thought that a translator translated machine code into source code or that it translated code into something the computer could understand, without specifying what that was.

Question 5 (b) (ii)

(ii) Explain **two** differences between a compiler and an interpreter.

Difference 1 .....

.....

.....

.....

Difference 2 .....

.....

.....

.....

[4]

This question was well answered by many candidates who showed two distinct differences.

Question 5 (d)

(d) Describe the purpose of code optimisation.

.....

.....

.....

..... **[2]**

Many candidates gave good descriptions of how code is optimised, but they did not answer the question which asked what the purpose of optimisation is.

Question 5 (e) (iii)

(iii) Give **two** differences between ASCII and Unicode.

Difference 1 .....

.....

Difference 2 .....

.....

[2]

Candidates should be encouraged to give a complete answer. Just saying 'Unicode uses more bits than ASCII' is not enough to be given a mark at this level.

Question 5 (f)*

(f)* The programmer has been asked by a client to create a complex computer program. Compare the spiral model and waterfall lifecycle methodologies for this task.

You should include the following in your answer:

- how both methodologies could be used to develop a complex computer program
- the benefits of each methodology for this task
- the drawbacks of each methodology for this task. **[9]**

Most candidates gained some marks on this question. Most could explain that spiral was iterative and waterfall was done in linear stages, but many did not expand on this. Few candidates linked their answer to the complex computer program mentioned in the question. Some candidates also described waterfall as iterative.

Question 6 (a) (i)

6 Anika's computer runs a multi-tasking operating system. She has access to a printer and a broadband internet connection through a wireless connection. The operating system uses scheduling algorithms such as first come first served and round-robin.

(a) (i) Explain why the computer's operating system uses a first come first served algorithm when sending documents to the printer.

.....

.....

.....

..... **[2]**

This question was generally well answered with many candidates gaining at least 1 mark. The question asked why the OS used 'first come first served' and many candidates were not given marks for stating why the user would want the OS to use it. Some candidates talked about other scheduling algorithms even though this was not relevant to the question.

Question 6 (b) (i)

(b) Anika uses an encrypted messaging program to communicate with her friends. The computer uses the TCP/IP stack.

(i) Explain what happens at the application layer of the TCP/IP stack when using this program.

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.....

..... **[5]**

Very few students could explain what happens at the application layer and answers tended to be about splitting data into packets. Some candidates did mention that encryption would take place but didn't go on to mention decryption when receiving data. Those candidates that identified that protocols are applied here were unable to give a specific example and simply listed protocols they knew, but without context.

Question 6 (b) (ii)

(ii) Explain what happens at the link layer (sometimes referred to as the "network interface layer", "network access layer" or simply the "network layer") of the TCP/IP stack when using this program.

.....

.....

.....

..... **[2]**

Very few candidates were able to gain 2 marks on this question. Some candidates talked about transmitting data via cables, despite wireless being mentioned in the question.

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