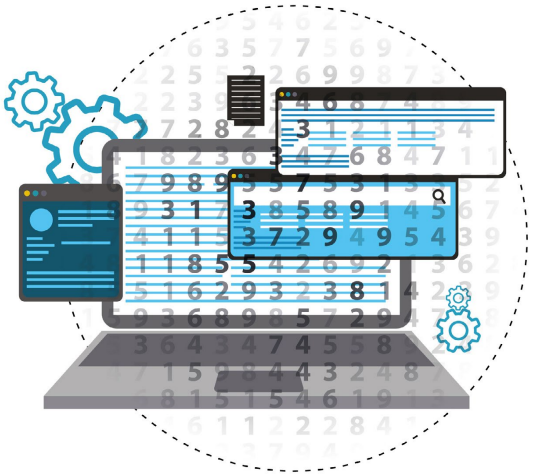
Cambridge Assessment International Education

Example Responses – Paper 1

Cambridge International AS & A Level

Computer Science 9618

For examination from 2024



Cambridge Pathway

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Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge International AS & A Level Computer Science.

This booklet contains responses to all questions from June 2024 Paper 13, which have been written by a Cambridge examiner. Responses are accompanied by a brief commentary highlighting common errors and misconceptions where they are relevant.

The question papers and mark schemes are available to download from the School Support Hub

9618 June 2024 Question Paper 13

9618 June 2024 Mark Scheme 13

Past exam resources and other teaching and learning resources are available from the School Support Hub

Question 1

1 **(a)** Complete the following description.

A kibibyte has a .....binary..... prefix. Three kibibytes is the same as .....3072..... bytes.

A megabyte has a .....denary..... prefix. Two terabytes is the same as .....2000..... gigabytes.

[4]

Examiner comment

There was considerable confusion between the two different sets of measurements, especially when candidates attempted to express the multipliers in powers of 2 or powers of 10. In questions like this, it is simpler to use 1024 instead of 210 when working with the binary prefixes kibi and mebi, etc. and 1000 instead of 103 when working with the denary prefixes kilo and mega, etc. The two calculations in the question above then become (3 * 1024) and (2 * 1000).

(b) Convert the denary number 241 to hexadecimal.

(241 = 128 + 64 + 32 + 16 + 1 or 1111 0001 in binary or F1 in hexadecimal) Answer = F1 [1]

Examiner comment

Some candidates found converting from denary to hexadecimal difficult and some working out was needed. As long as the answer was clearly indicated, candidates did not need to complete the working elsewhere.

(c) State what is meant by an **overflow in binary addition**.

The answer is too long to be represented in the same number of bits as the binary numbers being added. [1]

Examiner comment

Candidates tended to assume that the binary addition was completed with 8-bit binary values. Answers such as 'the answer was greater than 255' or 'the answer contains 9 bits' were often seen with no reference to the number of bits in the binary values being added. There was no length stated in the question, so a generic response was expected that applied to binary values of any length. The important concept was that the answer was longer than the number of bits allocated for it, however many bits that might be.

(d) Computers use character sets when representing characters in binary.

(i) Complete the table by identifying the number of bits each of the character sets allocates to each character.

Character set	Number of bits
ASCII	7
extended ASCII	8
Unicode	16

[1]

Examiner comment

Some candidates thought that the ASCII character set had 8 bits and extended ASCII had 16 bits.

(ii) Explain how the word 'Clock' is represented by a character set.

Each character in the word 'Clock' has a unique binary code. These binary codes for each character are stored in the same sequence as the letters in the word. [2]

Examiner comment

Some candidates omitted any statement about the uniqueness of the binary representation of each character.

Question 2

2 A photograph is stored as a bitmap image.

(a) The photograph has a resolution of 4000 pixels wide by 3000 pixels high. The bit depth is 4 bytes.

Calculate an estimate for the file size of the photograph in megabytes.

Show your working.

Working $\frac{(4000 \times 3000 \times 4)}{(1000 \times 1000)}$

Answer 48 megabytes

[2]

Examiner comment

- Some candidates multiplied the numerator by 8 to convert it to bits rather than bytes, but then omitted the 8 in the divisor to bring it back to bytes before converting to megabytes.
- Frequently, candidates completed the calculation in the numerator before starting the division to convert to megabytes. This often led to an incorrect final answer because of errors in the multiplication. It is better to leave all the calculations until the end, when values will probably cancel out.

(b) The photograph is compressed before being uploaded to a web server.

(i) Give **three** benefits of this photograph being compressed using lossy compression instead of lossless compression.

1 The file takes up less storage space on the web server than if lossless compression was used and so more photographs can be stored.

2 The file will also take less time to upload or download.

3 The file uses less bandwidth during transmission.

[3]

Examiner comment

- Candidates often used the incorrect terminology, writing 'memory' when they meant 'storage'.
- There was a tendency to write about faster transmission speed. It is important to differentiate between transmission speed and the time taken to transmit the file. A smaller file will transmit at the same number of bits per second, however, because the file is smaller there will be fewer bits to transmit and so the time taken to transmit the file will be reduced.

(ii) Explain how run-length encoding (RLE) will compress the photograph.

Run Length Encoding identifies consecutive repeating pixels of the same colour and stores the colour code and the number of times it repeats.

[2]

Examiner comment

- Candidates tended to omit any reference to the repeating pixels being adjacent to each other.
- Often candidates described the compression of a text file rather than the compression of the photograph or image file, writing about repeating characters rather than repeating pixels.

(c) Identify **two** elements of a bitmap image that can be changed to reduce its file size.

1 bit depth

2 image resolution

[2]

Examiner comment

Some candidates thought that reducing the screen resolution would reduce the file size of a bitmap image.

Question 3

3 The following table shows part of the instruction set for a processor. The processor has two registers: the Accumulator (ACC) and an Index Register (IX).

Instruction		Explanation
Opcode	**Operand**	
LDM	#n	Immediate addressing. Load the number n to ACC
LDD	<address>	Direct addressing. Load the contents of the location at the given address to ACC
LDI	<address>	Indirect addressing. The address to be used is at the given address. Load the contents of this second address to ACC
LDX	<address>	Indexed addressing. Form the address from <address> + the contents of the index register. Copy the contents of this calculated address to ACC
LDR	#n	Immediate addressing. Load the number n to IX
ADD	#n/Bn/&n	Add the number n to the ACC
ADD	<address>	Add the contents of the given address to the ACC
DEC	<register>	Subtract 1 from the contents of the register (ACC or IX)
SUB	#n/Bn/&n	Subtract the number n from the ACC
SUB	<address>	Subtract the contents of the given address from the ACC
INC	<register>	Add 1 to the contents of the register (ACC or IX)
<address> can be an absolute or a symbolic address # denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001010 & denotes a hexadecimal number, e.g. &4A		

(a) The current contents of memory are shown:

Address	Data
48	51
49	6
50	48
51	50
52	49
53	50
54	6

The current contents of the ACC and IX are shown:

ACC	2
IX	50

Complete the table by writing the content of the ACC after each program has run.

Program number	Code	ACC content
1	LDM #50 INC ACC SUB #1	50
2	LDI 51 ADD 52	97
3	LDR #2 LDX 50 DEC ACC	48
4	LDD 52 SUB 54 INC ACC	44

[4]

Examiner comment

- Some candidates did not understand the different types of operand and used denary values instead of the contents of the appropriate memory location.
- When the code fragments are traced in the table, candidates must ensure that their final answer is clearly indicated.

(b) The processor includes these bit manipulation instructions:

Instruction		Explanation
Opcode	**Operand**	
AND	#n/Bn/&n	Bitwise AND operation of the contents of ACC with the operand
AND	<address>	Bitwise AND operation of the contents of ACC with the contents of <address>
XOR	#n/Bn/&n	Bitwise XOR operation of the contents of ACC with the operand
XOR	<address>	Bitwise XOR operation of the contents of ACC with the contents of <address>
OR	#n/Bn/&n	Bitwise OR operation of the contents of ACC with the operand
OR	<address>	Bitwise OR operation of the contents of ACC with the contents of <address>
LSL	#n	Bits in ACC are shifted logically n places to the left. Zeros are introduced on the right-hand end
LSR	#n	Bits in ACC are shifted logically n places to the right. Zeros are introduced on the left-hand end
<address> can be an absolute or a symbolic address # denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001010 & denotes a hexadecimal number, e.g. &4A		

The current contents of memory are shown:

Address	Data
100	00001101
101	10111110
102	11110011
103	00110111
104	00000000

The current content of the ACC is shown:

1	1	1	1	1	1	1	1

Complete the table by writing the content of the ACC after each instruction has run.

The binary number 11111111 is reloaded into the ACC before each instruction is run.

Instruction number	Instruction	ACC content
1	LSL #2	1111 1100
2	XOR 100	1111 0010
3	AND 103	0011 0111

[3]

Examiner comment

Some candidates performed the equivalent of a logical shift right, rather than a logical shift left, and gave the incorrect answer 0011 1111 for the first instruction.

Question 4

4 A theatre wants to use a database to store data about the shows that are scheduled, their customers and the seats that the customers have booked.

In the theatre:

- Each show can take place on multiple dates.
- Some dates can have more than one performance.
- There are multiple rows of seats.
- Each seat can be individually booked by its row letter and seat number, for example row E seat 2.

Part of the database design includes these tables:

SHOW(ShowID, Title, Duration)

SEAT(SeatID, RowLetter, SeatNumber)

PERFORMANCE(PerformanceID, ShowID, ShowDate, StartTime)

(a) Identify the relationship between the tables PERFORMANCE and SHOW.

many-to-one

[1]

Examiner comment

Some candidates gave the answer as one-to-many without specifying the tables. An answer of one SHOW to many PERFORMANCEs was acceptable, but without the table names it did not answer the question.

(b) Sample data for the table PERFORMANCE is shown:

PerformanceID	ShowID	ShowDate	StartTime
0001	MK12	5/5/2025	13:00
0002	MK12	5/5/2025	19:30
0003	MK12	6/5/2025	19:00
0004	OP3	7/5/2025	18:30
0005	OP3	8/5/2025	18:30
0006	OP3	9/5/2025	13:00

Write a Structured Query Language (SQL) script to define the table PERFORMANCE.

```
CREATE TABLE PERFORMANCE(
PerformanceID varchar NOT NULL,
ShowID varchar,
ShowDate Date,
StartTime Time,
PRIMARY KEY(PerformanceID),
FOREIGN KEY(ShowID) REFERENCES SHOW(ShowID)
);
```

[4]

Examiner comment

- The data type for the PerformanceID was often incorrectly given as integer. The sample data shows that there are leading zeros, which would be lost with the integer data type.
- Care needs to be taken with the syntax, particularly the positioning of the commas and brackets.
- Candidates often forgot to include the foreign key.

(c) Write an SQL script to return the number of times each show is scheduled. For example, in the sample data in part **(b)**, the show MK12 is scheduled three times.

The result needs to include the show name and a suitable field name for the number of times it is scheduled.

```
SELECT SHOW.Title, Count(PERFORMANCE.PerformanceID)
AS NumberOfShowings
FROM PERFORMANCE INNER JOIN SHOW
ON PERFORMANCE.ShowID = SHOW.ShowID
GROUP BY SHOW.Title;
```

[4]

Examiner comment

- Some candidates attempted to implement an SQL script to return just the results for the show MK12 given in the example, rather than giving a script which would return the number of times each show was scheduled.
- The `GROUP BY` clause was frequently omitted.
- Some candidates who chose to use the `INNER JOIN` statement incorrectly followed it with a `WHERE` clause instead of an `ON` clause.

(d) Customers give their first name, last name and email address when they are making a booking. One booking can include multiple seats.

Describe the additional tables that will need to be included in the database **and** explain how these tables will be linked within the database.

Three additional tables will be needed. One called CUSTOMERS will hold data about the customers, another called BOOKINGS will hold data about the bookings made by customers. Each customer can make many bookings, but each booking will be for just one customer and one performance (two many to one relationships). Because customers can book more than one seat at a time there will be a many to many relationship between the BOOKINGS table and the SEAT table, so a linking table will be needed.

The CUSTOMER table will include the customer's first name, last name nd email address. It will also have a primary key CustomerID. The BOOKING table will have a primary key, BookingID and foreign keys to link the BOOKING table to the CUSTOMER table and the PERFORMANCE table. The foreign keys will be CustomerID from the CUSTOMER table and PerformanceID from the PERFORMANCE table. The linking table could be called SEAT_BOOKING, with a primary key SeatBookingID and foreign keys to link to the BOOKING and the SEAT tables. The foreign keys will be BookingID from the BOOKING table and SeatID from the SEAT table. [5]

Examiner comment

- There was very little evidence of any planning for this question.
- The question asked for additional tables. Some candidates attempted to modify the tables given in the question.
- Many of the solutions used just two additional tables and included the SeatID in the BOOKING table, overlooking the statement given in the question that a booking can include multiple seats. This would result in a many-to-many relationship that should be reduced by means of a linking table.

Question 5

5 A multimedia design company has an office with a LAN (local area network). The LAN can have up to 20 devices connected with cables and other devices connected using wireless access.

(a) The company has private cloud storage for its employees to store their work.

(i) Define the term **private cloud**.

Dedicated storage on a remote server only available to company employees. [1]

Examiner comment

Some candidates only defined a cloud while others only defined what was meant by something being private.

(ii) Describe the benefits to the company of using private cloud storage instead of public cloud storage.

The company is not reliant on a third party, and so they have greater control over things like security and backup. Another benefit is that the storage can be tailored exactly to company requirements.

Examiner comment

- There was a tendency to describe generic benefits to individuals of using cloud storage, rather than the benefits to a company of using private cloud storage.
- There is also a misconception that public cloud services are wide open to unauthorised access and that anyone can access them without any authentication. Using a private cloud the company will have more control over the security of their data, but it may actually be less secure than data stored on a public cloud. The level of security depends on many other factors.

(b) Part of the internal structure of the wired LAN is a star topology.

Explain how packets are transmitted between two devices in a star topology.

The sending computer transmits the packets directly to the central device. The central device checks the destination address of the packet and forwards it directly to only the destination device. [2]

Examiner comment

- Candidates often omitted any reference to checking the destination address.
- Terms such as 'data', 'information' and 'package' were often used incorrectly, instead of 'packet'.

(c) A different part of the network uses the Ethernet protocol.

(i) A collision is detected.

Describe how the collision is managed using Carrier Sense Multiple Access/Collision Detection (CSMA/CD).

When a collision is detected, the sending device transmits a jamming signal and transmission is aborted. The device waits a random amount of time before attempting to send the data again. If there is a further collision, the random waiting time is increased. [2]

Examiner comment

There was a misconception that the CSMA/CD was performing the required actions. CSMA/CD is a protocol, or a set of rules, and therefore it cannot 'do' anything. The protocol simply lists the actions to be taken by the devices in the network. Answers such as, 'when a collision occurs CSMA/CD sends a jamming signal' demonstrated a lack of understanding of what is meant by a protocol. A better answer would be, 'when a collision occurs, a jamming signal is transmitted from the sending device'.

(ii) Identify **two** drawbacks of using CSMA/CD.

1 *The random waiting time is increased each time, so some devices can wait indefinitely.*

2 *There may be constant jamming signals sent, so no transmissions are possible.*

[2]

Examiner comment

Some candidates found it difficult to identify two drawbacks and simply restated the answers from the previous question.

(d) The devices in the office have static private IP addresses.

State what is meant by a **static private IP address**.

Static means the IP address for that device does not change and private means it is only visible within the LAN. [1]

Examiner comment

Some candidates only stated what was meant by a static IP address, without also stating what was meant by a private IP address.

Question 6

6 Each of the following truth tables has three inputs (**A**, **B** and **C**) and one output (**X**).

Draw **one** line to match each truth table with its logic expression.

Truth table

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

A	B	C	X
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

Logic expression

- NOT (**A** XOR **B**) AND **C**
- (**A** OR **C**) AND NOT **B**
- **A** NAND **B** NAND **C**
- (**A** NAND **B**) OR **C**
- NOT (**A** AND **B** AND **C**)

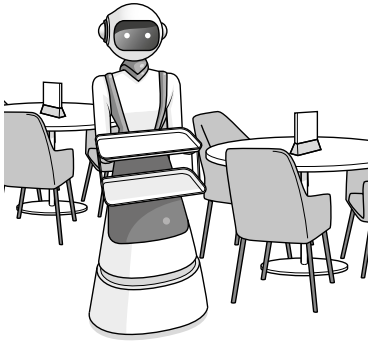
[3]

Examiner comment

Some candidates drew more than one line from some of the truth tables. The question asked for one line.

Question 7

7 Robots are used to serve food and drink to customers at a restaurant.



(a) A robot navigates through the restaurant to the table it is serving.

Complete the table by identifying **two** sensors that can be included in the robot **and** the purpose of each sensor in the navigation system.

Sensor	Purpose of sensor in navigation system
pressure	To detect if a table or other obstacle has been hit.
sound	To detect if someone is speaking so that the robot can use AI to decipher the speech and decide whether it is required to stop.

[2]

Examiner comment

Some candidates gave purposes for the sensors which were not part of the navigation system.

(b) The robot uses Artificial Intelligence (AI) to communicate with the customers. The customers speak to the robot to order their food and drinks.

Explain how AI will be used in this part of the robot.

Speech recognition is used to identify if someone speaking. The sound is recorded and analysed, and then the audio recordings are compared to a database to identify the word that has the highest probability of being the one spoken by the customer.

[3]

Examiner comment

Some candidates described the ordering process that takes place after the robot has taken the order, but the question asked how the Artificial Intelligence would be used to communicate with the customer.

(c) The navigation system can be considered an example of a control system.

Describe how feedback is used in a control system.

Feedback ensures that a system operates within set criteria by enabling system output to affect subsequent system input, thus allowing conditions to be automatically adjusted.

[2]

Examiner comment

Some candidates found it challenging to describe how feedback is used in a control system and described verbal feedback on the performance of the robot waiter instead.

(d) The robot includes a touchscreen for the customer to make their payment.

Describe the principal operation of a touchscreen.

When using a resistive touch screen, the pressure on the screen causes the layers to make contact and an electrical circuit is completed. If it is a capacitive touch screen, the electrical charge at the point of contact changes. These changes allow the point of contact to be identified and the coordinates of the point of contact can be calculated by a microprocessor.

[4]

Examiner comment

- Some candidates confused resistive and capacitive touchscreens.
- Some candidates struggled with the two technical names.

(e) Program libraries were used when writing the robot's software.

(i) State what is meant by a **program library**.

Pre-written routines that can be imported and called in another program.

[1]

Examiner comment

Some candidates simply stated that the routines could be used in other programs. This is not specific enough.

(ii) Some program libraries include Dynamic Link Library (DLL) files.

Describe the benefits of a programmer using a library with DLL files instead of using a library that does not include DLL files.

One benefit is that maintenance does not need to be done by the programmer because the DLL is separate from the calling program. Also, the source code does not need modifying when a DLL file changes and the programmer does not need to recompile the calling program because the DLL file can be updated independently of the calling program. An additional benefit is that any updates will automatically apply to all programs that use the DLL file.

[4]

Examiner comment

Candidates often gave answers that applied to all library files and not specifically to DLL files. The question asked specifically for the benefits of DLL files rather than libraries that do not include DLL files.

(f) The data from the robots is transmitted to a central computer using a wireless connection.

(i) Complete the table by identifying **and** describing **two** methods of data verification that can be used during data transfer.

	Method	Description
1	parity block	Parity is calculated horizontally and vertically. A parity byte is created from the bits produced by the vertical parity check. This is sent with the data. The parity is re-checked when received and the position of an incorrect bit can be determined.
2	checksum	A calculation is made from the data and the result transmitted with the data. The receiver repeats the calculation and compares the result with the value received. If the two are different, there is an error.

[4]

Examiner comment

- Some candidates overlooked the fact that the question asked for methods of verification during data transfer. Answers such as 'double entry' and 'visual check' which apply during data entry, not data transfer, were frequently given.
- There was a misconception among some candidates that if odd parity is chosen, then a 1 is added as the parity bit regardless of the number of 1s in the byte, and similarly if even parity is chosen then a 0 is added to the parity bit regardless.
- When describing the use of horizontal parity, some candidates wrote that the number of 1s in the data was counted and that a parity bit was added to the data. On its own this was too vague; 'byte' is the correct word rather than 'data'.

(ii) Explain how encryption can protect the security of data during transmission.

The data is scrambled and becomes cipher text, so that if it is intercepted it cannot be understood. A decryption key is needed to decode the data.

[2]

Examiner comment

Some candidates referred to encrypted data being unreadable, or inaccessible. This was not precise enough. A hacker could still access the data and read it, but because it is encrypted it would not be understood.

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