



GCE A LEVEL

1500U40-1



S25-1500U40-1

WEDNESDAY, 18 JUNE 2025 – MORNING

COMPUTER SCIENCE – A2 unit 4

Computer Architecture, Data, Communication and Applications

2 hours

1500U401
01

ADDITIONAL MATERIALS

A WJEC pink 16-page answer booklet.

A calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Answer **all** questions.

Write your answers in the separate answer booklet provided.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question; you are advised to divide your time accordingly.

The total number of marks available is 100.

Assessment will take into account the quality of written communication used in your answers.

Answer **all** questions.

1. Describe **three** limiting factors to parallelisation in parallel processing. [6]

2. (a) Convert the numbers 63_{10} and 30_{10} into 8-bit binary numbers.

Calculate the total that would result from adding the two binary numbers. Show your workings. [4]

- (b) Copy this table into your answer booklet. Complete the table to demonstrate the effect of carrying out two arithmetic shifts left on the two's complement, 8-bit binary representation of -58_{10} . [3]

								-58_{10}
								Shift 1
								Shift 2

- (c) Explain why two's complement is used in preference to sign and magnitude to represent negative values. Use 4-bit binary numbers as examples to illustrate your explanation. [3]

3. In a certain computer system, real numbers are stored in floating point form, using 16 bits as shown.

Mantissa	Exponent
12 bits in two's complement form. The binary point in the mantissa is immediately after the left bit.	4 bits in two's complement form.

- (a) Clearly showing your working, convert 75.75_{10} into this format. [3]

- (b) The value of 000001011010 0111 stored in this floating point form is to be saved as an integer in an 8-bit register. Compare the effects of rounding or truncating the stored value to suit the register. [3]

- (c) In a different computer system, real numbers are stored in floating point form, with an 8-bit signed mantissa and a 4-bit signed exponent.

Calculate the decimal value of $0.1101001\ 0100_2$. Clearly show your workings. [3]

4. (a) Multi-access and multi-tasking are two types of operating system.

Explain the terms multi-access and multi-tasking.

[4]

- (b) Partitioning of main memory is a responsibility of the operating system's memory management function.

Describe the different methods that can be used for partitioning main memory.

[6]

5. An assembly language program processes a set of theory test marks. A mark is compared with a pre-set pass mark and a '1' is output if a learner has passed the test and a '0' is output if the learner has not passed.

These commands are available in the assembly language instruction set:

Command	Description
INP	Inputs a numeric value to the accumulator
OUT X	Outputs a numeric value X
STA X	Copies the contents of the accumulator to memory location X
LDA Y	Loads the numeric value in location Y to the accumulator
SUB Y	Subtracts the numeric value in location Y from the accumulator, leaving the result in the accumulator
BRP	Branches if positive or zero to given label
BRA	Unconditional branch to given label
DAT	Indicates the location of stored data
HLT	Stop

Using the instruction set, write a program to compare the test mark entered with the pass mark that is also entered. The program should produce the required output.

[4]

6. Data mining and predictive analytics are techniques used in business management. Explain what is meant by the terms data mining and predictive analytics, giving an example of each technique.

[6]

7. Picsinc Ltd provide professional photography services. Its photographers can be booked to attend and photograph specific events. Picsinc use a database to record and organise the event bookings. These are examples from two tables in its database:

EVENT

EventID	Type	Day	Month	Location	CustomerNo
062406	Wedding	19	June	Swindon	240
062411	Awards ceremony	25	June	Bristol	332
072405	Wedding	4	July	Newbury	310
072414	Football match	11	July	Bristol	275
072418	Tennis club finals	14	July	Bath	240

CUSTOMER

CustomerNo	Title	Initial	Surname	ContactTel
240	Mr	B	Smidman	0776662214
275	Mr	D	Emery	0768863498
310	Ms	B	Patel	0977022667
332	Mrs	M	Smith	0268876645
175	Mr	G	Davies	0987556431

- (a) Write an SQL command to list the customer's **Surname** and **ContactTel** only for all events taking place in Bristol.

[3]

- (b) An additional table is required to record photographers' details. The required fields, with examples of records, are shown:

PHOTOGRAPHER

PhotographerID	Initial	Surname	Specialism	Degree	Contact
09	P	Wang	General	True	wang22@gmail.com
10	P	Silver	Portrait	False	silverpaul.1960@yahoo.co.uk
11	A	Jones	General	True	camera.jones10@gmail.com
12	W	Ahmed	Sport	True	w.ahmed33@outlook.com

- (i) Write an SQL command to create this table using suitable data types. [3]
- (ii) An extra record, ID 15, is to be entered into the Photographer table for Michelle Smith. Michelle has a BA(Hons) degree, is a sports photography specialist and uses Smith33mm@iCloud.com for work emails.

Write an SQL command to add Michelle's details to the table. [2]

8. Picsinc Ltd also operate picsinc.com, a website that sells high-resolution images to its registered customers. Its photographers specialise in landscape, seascape or wildlife photography and use a database to help organise the image library. Example records from this database are shown in the table:

Image ID	Photographer ID	Category	Subject	Download Cost	Download Count	Year
108	019	Landscape	Rain forest	50.00	234	2015
112	012	Seascape	Crashing waves	150.00	1753	2018
134	019	Landscape	Rolling hills	290.00	838	2022
196	023	Wildlife	Lioness with cubs	275.00	138	2024

A photographer may produce many images and images may be downloaded many times by customers.

- (a) Produce an entity relationship diagram for the image database in third normal form. [4]
 - (b) Design a structure for the image database clearly identifying all primary and foreign key fields required. [4]
 - (c) The database is to be designed to use restricted choice fields where possible. Describe, with reference to a field in the example records, the advantages of this form of validation. [3]
9. Picsinc are a company based in Wales. Picsinc's image library contains approximately 600 000 images, with a typical storage requirement of 4 MB per image.
- Picsinc are considering using an American based cloud backup provider but are concerned about the disruption that uploading the image library will cause. The cloud provider's maximum upload speed = 500 Mbps.
- (a) Calculate, to the nearest hour, the time required to upload the image library to the cloud provider's servers. Use the binary system where 1 KB = 1024 bytes. [4]
 - (b) In practice the image library upload took longer than the calculations suggested. Describe **two** areas that Picsinc could consider to reduce the image library upload transfer time. [4]

10. A Database Management System (DBMS) provides tools for the administration of relational databases.
- (a) Describe **three** administrative tasks that are carried out using a DBMS. [6]
 - (b) A contemporary relational database will utilise multi-level indexes to improve data retrieval times. Explain, using a diagram, the operation and benefits of a multi-level index. [6]
11. Explain the role of time-slicing and polling in CPU scheduling. [4]
12. The use of biometric technologies, such as facial recognition systems, is commonplace in many areas of society.
- (a) Describe the stages and complexities of using biometric systems to validate a person's identity. [4]
 - (b) Discuss the benefits and concerns arising from the mass collection, storage and use of biometric data. [8]

END OF PAPER

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