



GCE A LEVEL

A500U20-1



WEDNESDAY, 18 JUNE 2025 – MORNING

COMPUTER SCIENCE – A level component 2
Computer Architecture, Data, Communication and
Applications

2 hours 45 minutes

A500U201
01

ADDITIONAL MATERIALS

A WJEC pink 16-page answer booklet.

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.

You are reminded of the need for good English and orderly, clear presentation in your answers.

Answer **all** questions.

1. Most contemporary Central Processing Unit (CPU) specifications refer to word size and clock speed.
 - (a) Explain, using suitable examples, the relationship between word size and clock speed. [6]
 - (b) A computer specification will also refer to memory. Describe the different functions carried out by Random Access Memory (RAM) and Cache memory. [4]
2. Numbers are stored in computer systems in binary form.
 - (a) Calculate the sum of 58_{10} and 83_{10} using 8-bit binary numbers. Show your working. [4]
 - (b) Two's complement is a method of representing signed binary numbers.
Calculate the sum of 58_{10} and -83_{10} using two's complement. [2]
 - (c) The hexadecimal numbering system can be used to define colours on web pages and identify memory locations in RAM.
 - (i) Describe, the relationship between hexadecimal and binary numbering systems. Use an example. [2]
 - (ii) Describe **two** advantages of using hexadecimal numbering. [4]

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) Convert 105.125_{10} into the given floating-point format. Clearly show your working. [3]

- (b) 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 $0.1011011\ 0110_2$ in this computer system.
Clearly show your working.

[3]

4. A computer has a processor with four registers: R1, R2, R3 and R4 and will process an assembly language instruction set which includes these commands:

Command	Description
IN	Input numerical value X
LOR R, X	Load register R with the numerical value X
LDA R	Load the accumulator with the contents of register R
ADD S	Add the contents of register S to the accumulator
STA S	Copy the contents of the accumulator to register S
INC R	Add 1 to the contents of register R
DEC R	Subtract 1 from the contents of register R
JGZ S, LABEL	Jump to LABEL if the contents of register S are greater than zero
JEZ S, LABEL	Jump to LABEL if the contents of register S are equal to zero
ASR R	Perform an arithmetic shift right one place on register R
ASL S	Perform an arithmetic shift left one place on register S
LDR R, Y	Load register R with the contents of memory location Y
OUT R	Output the contents of register R

- (a) Memory location 1D holds the number $0111\ 1001_2$ and memory location 1E holds the number $0100\ 0110_2$.

Dry run this code to show the contents of the registers and accumulator at each step. [4]

```

LDR R1, 1D
LDR R2, 1E
ASR R1
LDA R1
ASL R2
ADD R2
STA R2

```

- (b) The triangular number sequence can be used to produce equilateral triangles of increasing size. The sequence is 3,6,10... and is calculated as
 $1 + 2 = 3$, $3 + 3 = 6$, $6 + 4 = 10$, $10 + 5 = 15$ etc.

The algorithm to generate the nth. number in the triangular number sequence is

```
Y = 1
Z = 1
T = 0
INPUT n
LOOP for 1 to n
    Z = Z + 1
    T = Y + Z
    Y = T
END LOOP
Out Y and Z
```

Write a program, using the given assembly language command set to calculate and output the tenth number in the triangular number sequence. [6]

5. The binary number 1101.11_2 is to be truncated to become a 4-bit integer.

- (a) Calculate the denary values of the absolute and relative errors that the truncation will produce. [2]
- (b) Compare the error produced in (a) with the percentage error produced when the binary number is rounded to 4 bits. [2]

6. Routers and switches are network devices that enable communication and data transmission.

Describe network routing and the role of routers in network communications. [6]

7. GigaHouse Webs Ltd (GHW) is a start-up web design company offering to create and host websites for commercial clients. It needs a relational database to keep records of its clients' products and online orders.

An order placed by an individual customer may involve many products. The customer will be offered alternative delivery options, including times and delivery address.

- (a) The database is to be structured into third normal form, using four tables.
- (i) Draw an entity-relationship diagram of a suitable database structure. [4]
 - (ii) Design a database for this situation. [4]
- (b) Boolean and string are two data types used in the GHW database. Describe the storage requirements of Boolean and string data types, give an example of each. [4]
- (c) GHW plan to offer Search Engine Optimisation (SEO) to promote the Search Engine Results Page (SERP) presence of its clients' websites.
- Identify **two** content areas that GHW will need to optimise to promote the SERP presence of the websites. [2]

8. GHW use a different database to record client details and to organise the project teams that develop and maintain the websites. These are examples from two tables in this database:

PROJECT

projectID	clientID	startDate	serviceType	teamNo	archived
02406	0044	19/01/17	eCommerce	09	N
02611	0145	18/02/19	eCommerce	08	Y
05405	0901	09/09/23	Design only	04	N
01414	0005	11/08/15	Marketing	01	Y
06218	0145	01/04/24	eCommerce	01	N

CLIENT

clientID	tradingName	category	contactName	contactTel
0005	C and R Traders Ltd	Hobby and DIY	Mr H Smithson	0776662214
0044	No Trend Market Ltd	Fashion	Miss J Emery	0768863498
0145	Kit Advantage	Sports	Mr F. Patel	0977022667
0901	Craft House DIY	Hobby and DIY	Mrs H. Smith	0268876645
1002	TechBest Limited	Electronics	Ms M. Davies	0987556431

- (a) Write an SQL command to output the **projectID** and **startDate** for all projects allocated to **teamNo** 01. [2]
- (b) Write an SQL command to list the **tradingName** and **category** only for all eCommerce projects that have not been archived. [3]
- (c) An extra record is to be entered into the PROJECT table for Craft House DIY. It is to be a design only service, allocated to **teamNo** 20 with **projectID** 07200. The **startDate** is 01/05/25. Write an SQL command to add the project's details to the table. [2]
- (d) An additional table is required to record details of the project teams. The required fields, with examples of records, are shown. Each team will have a team leader (tl) and 3 to 5 members depending on the nature and scope of the project.

TEAM

teamNo	tlID	tlName	Mem1ID	Mem2ID	Mem3ID	Mem4ID	Mem5ID
01	PW 1	Phil Winters	WJ 2	BV 1	NE 1	HY 1	AS 3
02	ML 1	Maya Liu	MG 1	RJ 1	AS 3	WJ 2	
19	AJ 2	Alan Jones	NE 2	GH 2	JJ 2	NE 2	
20	PW 1	Phil Winters	HY 1	AS 1	AW 1		

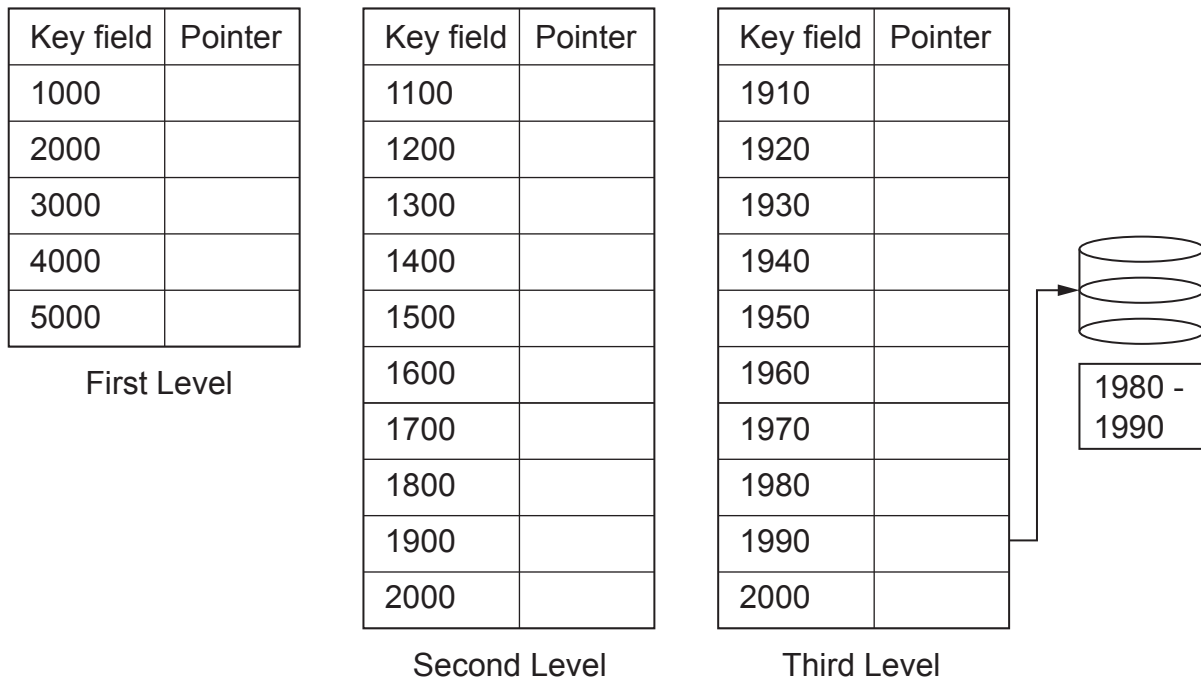
Write an SQL command to create this table using suitable data types.

[3]

9. Craft House DIY use a three-level indexed sequential file system to store product records which have key field values in the range 0000 to 4999.

Product records are stored on disk in data blocks. Each data block may contain up to 10 product records. Records within any one data block are sorted sequentially by key field values, which differ only in the last digit, e.g. 1470 to 1479.

To save memory space, index blocks are created when required. At present, only these three index blocks have been created.



Assume the computer searches sequentially down the keys until it finds the first key which is **greater** than the **search key**.

- (a) Explain how the computer would access product record 1955. [3]

- (b) Explain how new product records 2892 and 2893 would be added to the system, with reference to creating index and data blocks. [5]

10. Craft House DIY has an internal wireless network in its offices. The transfer rate on the network is 20 Mbps.

Calculate the time required, to the nearest second, to transfer 30 MB of data between two workstations on the network. Show your working. [4]

11. GHW use file archiving software and intend to offer a data warehouse for their clients.

(a) Identify **two** uses of file archiving software. [2]

(b) Explain the term 'data warehouse'. [4]

12. As a computer security consultant, you have been asked by an organisation to give advice on how to protect the security and integrity of its data.

The organisation receives orders via the internet, stores data about customers and staff, and has its own remote networked backup facility.

Write a report describing measures the organisation should take to protect the security and integrity of its data. [10]

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