GCE A LEVEL

A500U20-1

S18-A500U20-1

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

FRIDAY, 15 JUNE 2018 – MORNING

2 hours 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	8	
2.	4	
3.	11	
4.	6	
5.	11	
6.	4	
7.	8	
8.	9	
9.	5	
10.	10	
11.	16	
12.	8	
Total	100	

A500U201
01

ADDITIONAL MATERIALS

A WJEC pink 16 page answer booklet.

INSTRUCTIONS TO CANDIDATES

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. A shipping company uses a database to organise information about the containers which are carried on its ships. Two tables are shown below:

VOYAGE

VoyageID	ShipName	ArrivalDate	ArrivingFrom
108	Oriental Carrier	03 June 2018	Shanghai
112	Sarah Ann	12 June 2018	New York
134	Viking Seafarer	26 June 2018	Rotterdam

CONTAINER

ContainerID	VoyageID	Client	Contents	Weight
6291	108	Trent Computers	electronics	4.9
7821	112	Highstreet Fashion plc	clothing	3.7
9215	108	Merivale Engineering	machinery	5.9

(a) Write an SQL command to list the ***ArrivalDate*** and ***ShipName*** for each VOYAGE record. [2]

(b) Write an SQL command to list the ***ContainerID*** and **Contents** for all containers on voyages ***ArrivingFrom*** 'Shanghai'. [3]

An additional table is required to record the dispatch of containers from the port. Fields, with examples of records, are shown below:

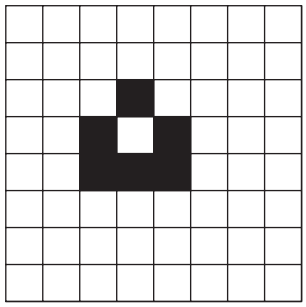
DISPATCH

ContainerID	Dispatched	Date	Transport
6291	TRUE	05 June 2018	Lorry
7821	FALSE		
9215	TRUE	06 June 2018	Rail

(c) Write an SQL command to create this table using suitable data types. [3]

2. Each row of pixels in a bit-mapped graphics character is created by specifying an 8-bit binary number. A bit value of 0 represents a white pixel, whilst a bit value of 1 represents a black pixel.

The character shown below is represented by the bytes in memory locations 2000-2007.



Address	Byte							
2000	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0
2002	0	0	0	1	0	0	0	0
2003	0	0	1	0	1	0	0	0
2004	0	0	1	1	1	0	0	0
2005	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0

Explain how shift operations can be used to carry out the following animations of the graphics character.

(a) Scrolling the character to the left until it disappears from the grid area. [2]

(b) Scrolling the character continuously from left to right, so that pixels leave the right of the grid and reappear immediately on the left of the grid. [2]

3. Owners requiring major work to be done on their properties have to make an application and comply with building regulations. Work is inspected at intervals until completed satisfactorily. A database with two tables is used to monitor building inspections. Example records are shown below:

APPLICATION

ApplicationID	PropertyLocation	WorkDescription	ApplicantID	ApplicantName
738	27 High Street	Loft conversion	678	J. Edwards
791	Rose Cottage	Kitchen extension	123	A. Munna
839	6 Station Road	Garage construction	678	J. Edwards

INSPECTION

InspectionID	Date	ApplicationID	InspectorID	InspectorName	Comments
1031	12 July 18	738	P62	W. Green	Inspect again in August
1052	16 Aug 18	738	P42	R. Liu	Completed satisfactorily
1066	19 Aug 18	791	P62	W. Green	Plumbing defective

The database is not currently in third normal form.

(a) Explain why the database is not in third normal form. [2]

(b) The database is to be restructured into third normal form.

(i) Draw an entity-relationship diagram for the revised database structure. [4]

(ii) Design a database for this situation. [5]

4. Describe the most suitable mode of operation for the following applications: [6]

- Gas billing
- Traffic Lights
- Theatre Booking

5. Different protocols are used on a wide area network:

(a) Both IMAP and SMTP are used in the e-mail system. Explain the different tasks carried out by these protocols. [2]

(b) Explain whether a FTP application should make use of TCP or UDP protocol to upload a web page to an Internet server. [3]

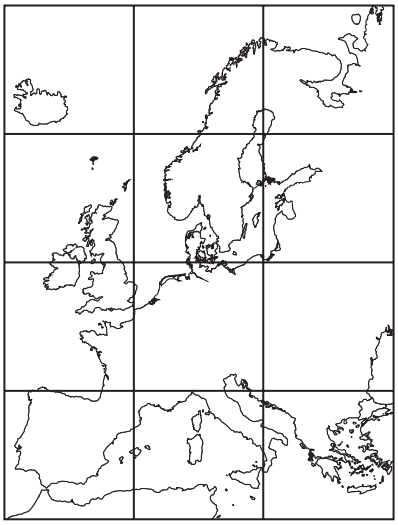
(c) Explain whether a video streaming application should make use of TCP or UDP protocol. [3]

(d) Explain the role of DHCP protocol in relation to IP addresses. [3]

6. A weather forecasting system for Western Europe receives data from many weather stations and then uses complex mathematics to predict weather patterns. The total time necessary for a single processor computer to carry out a run of the meteorological model is 5 hours.

(a) State why a single processor computer is inadequate for this weather forecasting system. [1]

(b) Parallel processing is to be used instead. The forecast region is divided into 12 areas, with a separate processor handling calculations for each area.



80% of the total processing can be run in parallel, whilst the remaining 20% of the processing involves exchange of data which must be carried out linearly.

Calculate the time that the meteorological model would take to run with 12 processors. [3]

7. The **Fibonacci sequence** is a series of numbers where each is found by adding up the two numbers before it. Starting with 0 and 1, the sequence is: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34…

An algorithm to generate the ***tenth number*** in the ***Fibonacci sequence*** is:

```
Num1 = 0
Num2 = 1
LOOP for 1 to 8
        NewNum = Num1 + Num2
        Num1 = Num2
        Num2 = NewNum
END LOOP
Output Num2
```

A computer has a processor with four registers: R, S, T and U.
The assembly language has an instruction set which includes the commands:

Assembly Language Command	**Description**
LOD R, X	Load register R with the numerical value X
MOV R, S	Copy the contents of register R to register S
ADD R, S	Add the contents of register R to register S, leaving the result in register R
INC R	Add 1 to the contents of register R
DEC R	Subtract 1 from the contents of register R
JGZ R, LABEL	Jump to LABEL if the contents of register R are greater than zero
JZE R, LABEL	Jump to LABEL if the contents of register R are equal to zero
OUT R	Output the contents of register R

Using assembly language commands and the algorithm above, write a program to calculate the ***tenth number*** in the ***Fibonacci sequence***. [8]

8. *(a)* A certain computer uses a floating point representation:

Mantissa 16 bits in two's complement form. The binary point in the mantissa is immediately after the left bit.	**Exponent** 8 bits in two's complement form

(i) Convert the number

$$138.375_{10}$$

into this floating point format. [2]

(ii) Convert the following floating point number to denary. [3]

0101 1000 0000 0000	0000 0111

(b) (i) The computer stores integers in two's complement format using 8 bits.

Show the negative number:

$$-17_{10}$$

In this two's complement format. [2]

(ii) Using 8 bits and two's complement format carry out the calculation $-17_{10} + 32_{10}$. Show all your working. [2]

9. A large organisation uses a mainframe computer with a multiprogramming operating system.

(a) Give **two** examples of interrupts which might be involved in controlling the processing of programs. [2]

(b) Describe how polling operates in a spooling system. [2]

(c) State why input and output buffers are necessary in a spooling system. [1]

10. Describe the storage of data in:

(a) random access files [6]

(b) indexed sequential files. [4]

11. *(a)* Many contemporary desktop computers use a hybrid storage combination of Solid State Drive (SSD) and Hard Disk Drive (HDD). Explain the advantages of this approach. [6]

(b) Explain the purpose of random access main memory and cache memory. Comment on the advantages of installing a large amount of main memory and cache memory. [6]

(c) Compare the operation of USB and Bluetooth as methods of connecting peripheral devices. [4]

12. *(a)* State what is meant by the term expert system. [2]

(b) For an expert system which you have studied, describe how it is used and discuss the benefits to the users of the system. [6]

END OF PAPER