

Candidate Name	Centre Number				Candidate Number			
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A LEVEL COMPUTER SCIENCE

UNIT 4

COMPUTER ARCHITECTURE, DATA, COMMUNICATION AND APPLICATIONS

SPECIMEN PAPER

2 hours

ADDITIONAL MATERIALS

In addition to this examination paper, you will need a 16 page answer book.

The use of a calculator is permitted in this examination.

INSTRUCTIONS TO CANDIDATES

Answer **ALL** question(s).

Write your answers in the separate answer book provided.

Write your name, centre number and candidate number in the spaces at the top of this page.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The total number of marks available is 100.

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

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

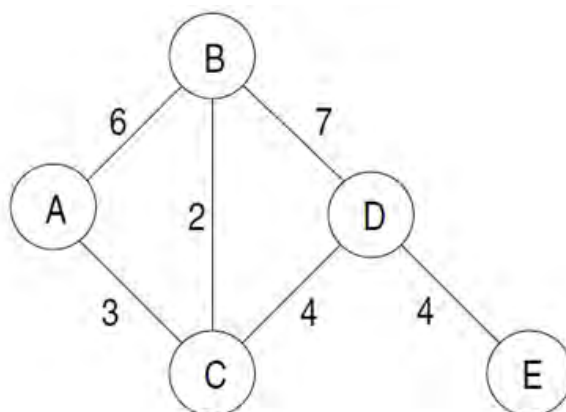
Unit 4
Answer all questions

1. (a) Explain the sequence of operations which will occur during the fetch phase of the fetch execute cycle, making clear the role of the PC (program counter), the MAR (memory address register) and the MDR (memory data register). [3]
- (b) In a certain computer, the following assembly language commands are available.

Assembly command	Description
STR R,X	Stores contents of register R in address X
DEC R	Decrement register R
CLR R	Clears the contents of register R
LSL R	Performs a logical shift left o register R
LOD R,X	Loads register R with the contents of address X
ADD R, S	Adds the contents of register R to the contents of register S

Write a simple program using the assembly language commands in the table above to demonstrate how two numbers can be added together and stored in a register. [3]

2. Explain the terms indexed sequential file and multilevel index. Draw a diagram to demonstrate the operation of a three-level index. [6]
3. Discuss random access files, making reference to:
- the purpose of a hashing algorithm
 - the need for an overflow area
 - the need for the random access file to be re-organised on occasions. [6]
4. Produce a forwarding table for node A, calculating the lowest cost routes on the network below. [3]
- You may assume traversal of a node costs zero.



5. Wales-Cycles owns a number of bicycle shops which sell bicycles, accessories, etc.

The table below shows some of items which it has for sale in its various shops, together with other information such as manufacturer details.

Item Code	Item Name	Shop Code	Shop Address	Shop Manager	Number In Stock	Manuf Code	Manuf Name	Manuf Contact
B2347	Smart Bike	S174	Manchester	Davies	4	M68	Dragon	Phillips
B2347	Smart Bike	S162	Bolton	Roggers	2	M68	Dragon	Phillips
A7219	Deluxe Hemlet	S162	Bolton	Roggers	12	M17	Safe Heads	Elhami
C2391	Peddles	S115	Stockport	Green	8	M68	Dragon	Phillips
C3844	Peddles	S162	Bolton	Roggers	5	M22	Fast Bikes	Kazembe
A1955	Bright Jacket	S201	Rochdale	Williams	22	M61	Nite Safe	Earley
A1955	Bright Jacket	S174	Manchester	Davies	16	M61	Nite Safe	Earley

The data in the table above has not been normalised.

- (a) Using examples from the table, describe **two** problems which result when data has not been normalised. [4]
- (b) Restructure the table shown above into third normal form. There is no need to copy the data items. [6]
- (c) Describe why distributed databases are often used and identify one difficulty associated with using distributed databases. Explain what is actually distributed in a distributed database. [3]

6. Two tables have been created in a database using SQL commands. They are:

PUPIL

PupNum	PupName	DateBirth	TeachNum
12675	Brown	02-Nov-96	307
13670	Jones	01-Jun-95	378
13777	Walker	23-Oct-95	307
14156	Vaas	29-Feb-96	307
14238	Thomas	18-Jan-95	378

TEACHER

TeachNum	TeachName	RoomNum
307	Kholi	106
345	Lester	113
378	Davies	113

- (a) Write an SQL command to output the names and teacher numbers of all the pupils. [1]
- (b) Write an SQL command to output the names of pupils who have the teacher with number 307. [1]
- (c) Write an SQL command to change the teacher number of all those pupils whose teacher number is currently 378. Their new teacher number should be 345. [2]
- (d) Write an SQL command to output the names of all pupils who have the same teacher as pupil 14238. [2]
- (e) Write an SQL command to create a new table COMPUTER to contain the serial numbers of each computer at the school (assume there is only one computer per room). [2]
- (f) Write an SQL command to enter the following data into the new table. [2]
- Room 106 should have a computer with serial number 13457
 - Room 113 should have a computer with serial number 66870

A certain computer uses two complementation and an 8 bit register.

7. (a) (i) Showing all your working, calculate the result of the binary addition of -7_{10} and 4_{10} . [2]

(ii) Showing all your working, calculate the result of the binary subtraction of 5_{10} from 12_{10} . [3]

(b) (i) Real numbers stored in floating point form can be stored using 16 bits as shown below:

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.)

Convert the number 5.625_{10} into this floating point form. Your final answer should be normalised. [3]

(ii) In a different computer system, the following is a floating point representation of a number, using an 8 bit mantissa and a 4 bit exponent:

$$0.1111000_2 \ 0011_2$$

Calculate the mantissa, exponent and decimal equivalent of the number. [3]

(iii) In the same computer system as Question 7(b)(ii), the closest possible representation of the denary number 6.9_{10} is shown below.

$$0.1101110_2 \ 0011_2$$

There can be a loss of accuracy when a denary number is stored using floating point representation.

Calculate the absolute and relative error that has occurred above and explain how the floating point system used could be modified to allow a more accurate representation of 6.9_{10} . [6]

(c) (i) Calculate the effect of carrying out an arithmetic shift left by two places on the eight-bit positive integer 00001111_2 and state the effect of this operation on the number. [2]

- (ii) If an arithmetic shift left by two places was carried out on the eight-bit positive integer 01001111_2 , a problem would arise. Name and describe the problem. [2]
8. Explain what is meant by Big Data and data mining. Giving an example, explain what is meant by predictive analytics. [4]
9. (a) An operating system on a large computer uses multiprogramming. Describe the main features of a multiprogramming operating system. [8]
- (b) (i) Explain what is meant by the term computer interrupt and describe three conditions or events which could generate interrupts. [4]
- (ii) Describe high priority interrupt handling. [3]
10. A new suspended railway system uses driverless trains. A computer system controls the movement of trains between stations. Discuss the possible benefits of this system. [3]
11. Explain the need for and the purpose of cryptography. [3]
12. Explain the limiting factors to parallelisation in parallel processing. [10]