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COMPUTER SCIENCE
STANDARD LEVEL
PAPER 1

Friday 4 November 2005 (afternoon)

1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Section A: answer all the questions.
- Section B: answer three questions.

SECTION A

*Answer **all** the questions.*

1. Outline **one** reason that software development is normally cyclical. *[2 marks]*

2. Assume that a video system stores colors as 6-bit integer values. State the number of different color values that can be stored in this system. *[1 mark]*

3. A satellite transmits data at 64 Kilobits per second. Calculate the approximate total storage requirements for storing 1 hour of data, and state the answer as a number of **Megabytes**. *[2 marks]*

4. Determine the output of this algorithm:

```
declare CHARS string
declare C integer
C <-- 0
CHARS <-- "abc"
repeat
    CHARS <-- concat(CHARS, CHARS)
    C <-- C + 3
    output C , ":" , length(CHARS)
until ( C > 8)
```

[2 marks]

Recall that **concat** joins two strings together.

5. Commercial software is normally compiled and then sold in an executable format, and the source code is not given to end-users.

(a) Outline **one** advantage of distributing compiled modules rather than distributing source code. *[2 marks]*

(b) Outline why distributing the source code would **not** be a good substitute for end-user documentation. *[2 marks]*

6. State **one** important function of the ALU (Arithmetic Logic Unit) and state **one** important function of the CU (Control Unit). *[2 marks]*

7. (a) State whether a disk-drive normally uses direct-access, sequential access, or neither. *[1 mark]*

(b) State whether a tape-drive normally uses direct-access, sequential access, or neither. *[1 mark]*

(c) Compare the use of tape-drives for backups to the use of hard-disk drives for backups. *[2 marks]*

8. Describe the difference between a *single-tasking* and a *multi-tasking* computer system. *[2 marks]*

9. Describe the function of a *defragmentation utility*. *[2 marks]*

10. A hotel keeps their financial records in a computer database, this includes names, addresses and salaries of employees. The hotel's management wishes to expand the use of computers to track customer information (name, address, phone, *etc.*). They hope to use this new database for advertising and to analyze the numbers of customers and frequencies of visits. Hotel employees will be able to access this database when customers make reservations, check-in, and check-out of the hotel.

(a) Identify the stage of the *software development cycle* when software developers collect needs and wishes from potential users. *[1 mark]*

(b) Explain the importance of formulating the problem precisely before programmers begin writing program code. *[3 marks]*

11. State **two** advantages of breaking a program into small modules rather than writing one long program. *[2 marks]*

12. State **one** reason why a bus topology network might be cheaper than star topology. *[1 mark]*

13. Explain why a server normally does not have browser software installed. *[2 marks]*

SECTION B

*Answer **three** questions.*

14. A telephone service uses the following algorithm to calculate the charges for telephone calls.

```
function CHARGE(MINUTES integer)
    result real

    declare TIME integer
    declare C integer
    declare T real
    declare PRICES real array[0..4]

    PRICES[0] <-- 0.20
    PRICES[1] <-- 0.45
    PRICES[2] <-- 0.35
    PRICES[3] <-- 0.30
    PRICES[4] <-- 0.15

    T <-- 0
    C <-- 0
    while (C <= MINUTES and C <= 4)
       T <-- T + PRICES[C]
       C <-- C + 1
    endwhile

    if (MINUTES > 4) then
       T <-- T + (MINUTES-4)*PRICES[4]
    endif

    return T

endfunction CHARGE
```

(a) Use the algorithm to calculate:

(i) `CHARGE`(2) *[1 mark]*

(ii) `CHARGE`(6) *[2 marks]*

(iii) `CHARGE`(-1) *[1 mark]*

(This question continues on the following page)

(Question 14 continued)

(b) Construct an algorithm for a function `COST` to calculate the cost for shipping packages at the post-office, according to the following rules:

Rule	Example
Any package under 1 kilogram costs **2.00**	(0.90) = 2.00
Packages from 1 kilogram up to 10 kilograms cost **2.50 per kilogram**	`COST`(5) = 5*2.50 = 12.50
Packages weighing more than 10 kilograms cost **3.00 per kilogram**	`COST`(15) = 15*3.00 = 45.00

[6 marks]

15. The World Organization for Weather Information (WOWI) collects data about temperature, air pressure, wind direction, and various other measurements. These measurements are recorded **each hour** in 100 cities around the world. WOWI also saves **satellite photos**.

All data and photographs are stored in a central computer in London, England. WOWI makes the data available, free of charge, to anyone who wants it. Typical users of the data are radio and television stations, for daily weather reports.

(a) Identify part of this system which requires analog to digital data conversion. *[1 mark]*

(b) State why encryption is not necessary in this system. *[1 mark]*

(c) State **one** reason for storing and distributing the satellite photos in a standard graphics format. *[1 mark]*

(d) WOWI uses a WAN for data collection. Data is transmitted each hour.

(i) Describe a suitable standard error-detection technique for use during transmission of temperature data. *[2 marks]*

Sometimes the WAN connections do not function for several hours.

(ii) Describe an appropriate response to this situation by the system. *[3 marks]*

(e) Data distribution uses the World Wide Web, but does **not** use HTML pages or web-browsers.

Explain why HTML pages are not suitable for transmitting large quantities of numerical data. *[2 marks]*

16. The Cheap Automobile Rental Service (CARS) rents cars to tourists. They have "paperless" offices at many airports and in many cities. All data is collected, stored, transmitted and displayed electronically. The company does not own any printers and does not store any paper records. When a customer rents a car, the employee types the name, credit card information, and automobile ID directly into a PC. The customer does not sign any paper forms. All information about cars, maintenance and repairs, customers, and employees is stored in a central server.

The system requires many software modules. Some of the software modules run only on the server, and others run only on the client PCs. All the software in the client PCs is stored in ROM.

(a) Outline **one** advantage and **one** disadvantage of storing software in ROM rather than storing it on a disk drive. *[2 marks]*

(b) Explain why RAM is still needed in the client PCs, even though all software is stored in ROM. *[2 marks]*

(c) Data is collected in the client PCs in the rental offices each day. At the end of the day, data is transferred to the server.

(i) State whether the daily data transfer is *batch processing*, *interactive processing*, or *real-time processing*. *[1 mark]*

(ii) Describe the need for backing store in the client PCs. *[2 marks]*

(iii) Once each day, the server collects all the rental information from all the offices into a transaction file, and then updates a master file. Explain the relationship between *master* and *transaction files*. *[3 marks]*

17. A programmer has decided to create a *compiler* for PURE - the IB pseudo-code language. The *compiler* will be called PUREC.

The first task is to create a text-file containing all the reserved words for PURE - it starts like this:

PUREWORDS
mod
div
not
and
or
repeat
.....

PUREC should not permit programs to use any of these reserved words as names for variables, procedures, or functions. The *compiler* is **not** case-sensitive - *e.g.* 'REPEAT' and 'repeat' are considered the same.
Thus the following code contains errors in the first line, third line, and fourth line:

```
declare REPEAT integer          /* error - REPEAT is used incorrectly */
output "Starting"
for REPEAT <-- 1 upto 5 do      /* error - REPEAT is used incorrectly */
  output REPEAT * 2            /* error - REPEAT is used incorrectly */
endfor
```

The compiler will read all the words from PUREWORDS into an array. When it compiles a program, it will check each variable name against the list of words in the array, and produce an error message if the word is found.

(a) (i) State whether using a reserved word as a variable name is a *syntax error*, a *logic error*, a *run-time error*, or none of these. *[1 mark]*

(ii) Outline how an *interpreter* would react when a reserved word is misused. *[1 mark]*

(b) The PUREWORDS file above is not sorted.

(i) State the name of a standard sorting algorithm which is appropriate for sorting the words. *[1 mark]*

(ii) Describe how PUREC can be made more efficient if the PUREWORDS file is sorted. *[2 marks]*

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(Question 17 continued)

(c) `PUREC` inputs program *source code* from a text-file, examines the program *source code* for errors, and produces an output file containing a list of error messages.

(i) Describe the process by which a programmer uses the error message file to debug the source code. *[2 marks]*

(ii) State a second output file, which must be produced by the *compiler*. *[1 mark]*

(d) Describe how `PUREC` can ignore the words written in comment statements. *[2 marks]*