Markscheme

November 2018

Computer science

Standard level

Paper 1

Section A

1. *Award [1] for identifying the nature of a network and [1] for a development of the first point up to [2 max].*

    A group of computers and other computing hardware devices that are linked together through communication channels/cables/wirelessly;
    To enable communication (sharing files, sharing information) between systems/among a wide range of users;   **[2]**

2. (a) *Award [1] for identifying a feature of a database management system and [1] for an expansion up to [2 max].*

    Database management system is an application software;
    that allows users to define/create/maintain a database / provides (controlled) access to the data;
    Examples of database applications are computerized library, inventory, flight reservation, *etc*;   **[2]**

    (b) *Award [1] of using beta testing and [1] for an expansion up to [2 max].*

    Beta testing is done from the user/client perspective;
    So, requirement mismatches can be easily identified;

    The real users have an opportunity to test a new product before it is (publicly) released;
    So, user acceptance is assured;
    Any bugs identified could be (easily) fixed before the public release of the product;
    So, quality of the product is enhanced;   **[2]**

3. (a) *Award [1] for an advantage up to [1 max].*

    Direct observation is systematic/structured process;
    Direct observation allows that current computer system can be studied in its natural setting;
    Direct observation provides a better understanding of the way computer system is used;
   *etc*.   **[1]**

    (b) *Award [1] for a disadvantage up to [1 max].*

    Direct observation is susceptible to observer bias;
    Direct observation also can affect the behavior of users/process being observed;
    Direct observation is time consuming;
    etc.   **[1]**

4.   *Award [3 max]*.

Award [1] for a logic diagram representing A OR B with 2 inputs, 1 output and 3 logic gates.
Award [1] for the OR gate having 2 inputs, one of which is NOT A.
Award [1] for another input to the OR gate, which is A AND B.
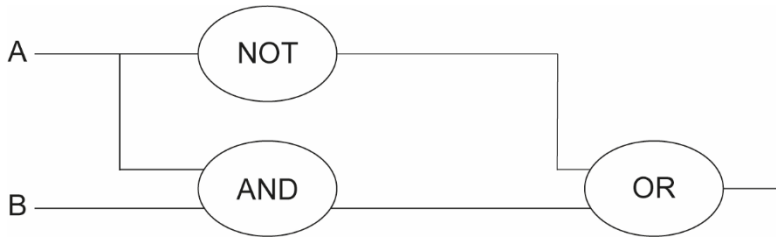
                                                                                        [3]

5.   (a)   *Award [1] for each possible compatibility issue identified up to [2 max]*.

                Language differences/different character set;
                Different conventions of representing various data/currencies, dates, *etc*;
                Incompatible software/incompatible hardware;   **[2]**

          (b)   *Award [1] for identifying how VPN will allow employees to communicate and [1]*
                for a development up to [2 max].

                VPN allows secure communication with the Head Office in Asia;
                A VPN is the company's private network that uses a public network (in this
                situation the Internet) to connect remote sites/employees together;
                Privacy is protected using VPN tunneling;
                VPN uses encrypted connections routed through the Internet from the company's
                private network (Europe) to the remote site in Asia (or employee);
                Hiding IP addresses to prevent unwanted exposure and data leaks;
                Data security is ensured by encryption – anyone intercepting the encrypted data
                cannot read it;   **[2]**

          (c)   *Award [1] for identifying an issue and [1] for an expansion up to [2 max]*.

                Employees who will not be willing to move to Asia;
                Lost jobs / finding new job / income decreased;

                Employees who will move to Asia;
                Personal or family issues during the period of moving or in a new environment /
                finances and cost of living / services such as schools, hospitals, transport /
                language problems;   **[2]**

6.   *Award [4 max]*.

          Packet switching entails data being separated into specially formatted units (packets);
          Each packet contains data and information such as packet number, address that
          identifies the sending computer and intended recipient, *etc*;
          Packets are routed from source to destination using (different) network switches and
          routers;
          Using these addresses, network switches and routers determine how best to transfer
          the packet on the path to its destination;
          Packets are reassembled at the destination (using packet numbers);
          If any of packets is missing it should be retransmitted;   **[4]**

7. *Award **[4 max]**.*

*Award **[1]** for a trace table with at least three columns.*
*Award **[1]** for each correct column (out of the four columns – A, B, B >= A, output).*

A	B	B >= A	output
3	7	true	
4	6		3
		true	
5	5		1
		true	
6	4		−1
		false	

[4]

Section B

8.   (a)   (i)   *Award **[3 max]**.*

RAM acts as temporary storage of data, instructions and programs currently running (for the operating system and for the running applications) whilst ROM is permanent memory (stores the instructions and data that won't change/stores the instructions that the computer needs in order to boot up;
Memory access, both read and write operations are performed on RAM whilst ROM works with read only operation;
If power failures happened during access to RAM then all data will be permanently lost/RAM is volatile memory/whilst if power failure happened during the ROM access no data will be lost/ROM is non-volatile memory; **[3]**

(ii)   *Award **[1]** for the answer saying that the function of OS in primary memory management is allocation of specific memory blocks to individual programs and **[1]** for reallocation up to **[2 max]**.*

A part of the OS (memory manager) assigns that block of memory to the program when a running program requests a block of memory;
When the program no longer needs the data in previously allocated memory blocks, they become available for reassignment;

OS ensures the availability of adequate memory for data structures/objects of each running program at all times;
By allocating the memory portions to programs after freeing the space (of the computer memory);

OS (memory management unit) uses virtual memory which provides secondary memory (external storage) for program that does not have enough space in RAM for execution;
After execution of the program this memory is reallocated (used by other programs)/freed;

*Note to examiners: Award only **[1]** an answer such as "OS maintains file allocation table".* **[2]**

(b)   *Award [4 max].*

Bus is defined as a system that transfers data between hardware components/data bus and address bus enable a processor to communicate with the primary memory;
When the computer processor needs to fetch an instruction from the memory it uses the address bus to specify the (physical) address (of the memory block it needs to access);
It will get the data from (the specific) memory (block) (after checking the address bus to get the read address);
And then it will place this data on to the data bus/data bus carries the data;
When the processor wants to store results of execution to the memory it will set the write address on the address bus;
And put the data/results/to be written to memory on to the data bus (to carry this data);   **[4]**

(c)   (i)   *Award [1 max].*
5E;   **[1]**

(ii)   *Award [1 max].*

2^8/256;   **[1]**

(iii)   *Award [1] for identifying why this byte could not be used to represent characters such as those in Chinese and [1] for an expansion up to [2 max].*

The characters must be represented as numbers so that computer can deal with them;
One byte (gives us the ability to represent only 256 characters) is enough to hold every possible character in a language which uses a limited set of text symbols, punctuation marks and special characters (for example, English, Spanish, *etc*);
Chinese exceeds the 256 character limit and therefore requires more bytes to represent all of the characters in this language;   **[2]**

(d)   *Award [2 max].*

Award [1] for all four input combinations (A,B).
Award [1] for all four correct output values (C).
Note: *1 == True, 0 == False.*

A	B	C
0	0	1
0	1	0
1	0	0
1	1	1

[2]

9. (a) *Award [1] for the answer identifying improved programmer productivity and [1] for making reference to machine independence up to [2 max].*

High-level language(HLL) provides statements (for example, high level `if`(…), `while`(…) , *etc*) which are not dependent on the specific machine / and ability to create various data structures;
Which saves the programmer's time;

Higher level languages are closer to human language;
So programmers find them easier to understand/work with than lower level languages;

HLL saves programmer from knowing details of computer architecture (and using all the specific (machine) instructions);
So giving more time to creating/developing the best way of coding a problem/process of coding is simpler and more understandable; **[2]**

(b) *Award [4 max].*
Mark as [2] and [2].

Award [1] for an answer stressing the usefulness of sub-procedures in any of the following:
Program organization;
Program coding;
Program testing;
Maintenance;
Etc.

Award [1] for the expansion up to [2 max].

Problem could be divided into smaller/easier parts;
Which means solving easier/smaller parts of the problem for one programmer;
Or for a team of programmers, each programmer could work on different smaller parts;

Simpler testing;
Each part of the program could be separately tested;
By the programmer who created the code or someone else in the team of programmers;

Reusable code;
Sub-procedures already written/tested could be used in various programs;

Simpler maintenance and changes;
Could be done only on required sub-programs; **[4]**

(c) *Award [3 max].*

Award [1] for data structure implementation/objects/elements of collections.
Award [1] for algorithms/methods/callback functions.
Award [1] for showing that collection reduces programming effort / increases performance (by providing efficient implementations of data structures and algorithms).

Award marks for description of a specific example collections (in Java or any other programming language) such as arrays, dictionaries, sets, lists, trees (they

have some characteristics in common, but also each of them has different way of organizing the data elements/objects they contain).

Collection is a container of discrete values;
Usually of the same type (primitive data values and also some other data structures);
(But) collection objects can be of different types (pointers afford a flexibility and thus collection objects permit references to any data structure as well as to primitive values);
Collections have a set of methods that define operations performed on the elements/objects of that collection;
Such as adding/removing elements to/from collection, comparing elements of collection, searching, *etc*;
Which reduces programming effort (because implementations of data structures and algorithms are provided);
Which increases performance of the program (because efficient implementations are provided); **[3]**

(d) *Award **[6 max]**.*

*Award **[1]** for initialization and for outputting **correct** result (COUNTER).*
*Award **[1]** for using collection methods.*
*Award **[1]** for correct loop.*
*Award **[1]** for retrieving a number (ELEMENT) from the collection.*
*Award **[1]** for if statement within the loop.*
*Award **[1]** for correct condition in if statement.*
*Award **[1]** for increasing COUNTER if needed.*

Example answer:

```
COUNTER = 0
NUMBERS.resetNext()
loop while NUMBERS.hasNext()
  ELEMENT = NUMBERS.getNext()
  if ELEMENT >= -1 and ELEMENT <= 1 then  // abs(ELEMENT) <= 1
    COUNTER = COUNTER + 1
  end if
end loop
output COUNTER
```

Note: *be flexible over the method names. For example, NUMBERS.getData() is acceptable instead of NUMBERS.getNext().* **[6]**

10. (a) *Award [1 max]*.

26.0; **[1]**

(b) *Award [4 max]*.

Award [1] for outputting 'underweight' and correct condition in if statement.
Award [1] for outputting 'normal weight' and correct logical expression
(18.5 < B < 25.0).
Award [1] for outputting 'overweight ' and correct logical expression
(25.0 < B < 30.0).
Award [1] for outputting 'obese' (30.0 and greater than 30.0).
Award [1] for using if-else.

Example answer 1:

```
category(B)
  if B < 18.5
    output('underweight')
  else if B < 25.0
    output('normal weight')
  else if B < 30.0
    output('overweight')
  else
    output('obese')
  end if
end category
```

Example answer 2:

```
category(B)
  if B < 18.5
    output('underweight')
  end if
  if B >= 18.5 and B < 25.0
    output('normal weight')
  end if
  if B >= 25.0 and B < 30.0
    output('overweight')
  end if
  if B >= 30.0
    output('obese')
  end if
end category
```
[4]

(c) *Award [1 max]*.

Paul; **[1]**

(d) (i) *Award [1 max].*

Binary search can be applied only on sorted array / array HEIGHT is not
sorted so binary search cannot be used;   **[1]**

(ii) *Award [1] for identifying each stage in the process of printing out a person's
name up to [2 max].*

Linear (sequential) search could be used to find the position (array index) of
a given height measurement in array HEIGHT;
And the name in array NAME at found position should be outputted;   **[2]**

(e) *Award [6 max].*

Award [3 max] marks for calculating average.
Award [1] for initialization and changing the sum (of all BMIs) within the loop.
Award [1] for a correct loop.
Award [1] for correct parameters in the call of method calcBMI().
Award [1] for calculating average for the 30 persons (sum of all BMIs over 30).

*Award [3 max] marks for displaying appropriate names **after** calculating the
group's average BMI.*
Award [1] for an if statement within the correct loop.
*Award [1] for condition in if (comparing the BMI of the person with the average
BMI).*
*Award [1] for the correct output [1] for correct parameters in the
method call (*calcBMI(HEIGHT[K], WEIGHT[K]*).*

Example answer:

```
sum = 0
loop for K from 0 to 29
  sum = sum + calcBMI(HEIGHT[K], WEIGHT[K])
end loop
average = sum/30

loop for K from 0 to 29
  if calcBMI(HEIGHT[K], WEIGHT[K]) > average then
    output(NAME[K])
  end if
end loop
```
[6]