COMPUTER SCIENCE
PAPER 1 SAMPLE
MOCK EXAM REVIEW ----> with answers

SL = 1 hour 30 min pages 1-7

HL = 2 hour 10 min pages 1-10

INSTRUCTIONS TO CANDIDATES

- Do not open this exam until told to do so.
- Answer all questions

Possible Misprints

It is possible that this exam paper contains misprints.
There should be NO misprints or syntax errors in any pseudocode.
If a misprint does occur in pseudocode, and this would cause an error,
then the candidate must do their best to correct this error and answer the question as if no misprint had occurred. The same applies to all questions, but this is especially important in programming questions. The answer to a programming question should never be "a syntax error prevents execution".

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Correct answers are *shown in italics* after each question.
Be award that **your exam answers should be longer**, clearer and usually written in full sentences.
The correct answers shown here are abbreviated.

(page 2 of 6 pages)

1. Explain the difference between **white-box testing** and **black-box testing.** *[2 marks]*
   ** White box = read the program without running it*
   ** Black box = run the program without reading it*

2. Explain one difference between **data validation** and **data verification**. *[2 marks]*
   ** Validation = is it possible, usable, correct format, believable*
   ** Verfification = checking for CORRECT data, usually by cross-check*

3. (a) State the largest positive number that can be stored in **8 bits**, assuming that no sign bit is used. *[1 mark]*
   ** 255 = 1+2+4+8+16+32+64+128*
   (b) State how the decimal number 21 would be stored in **8 bit binary**. *[1 mark]*
   ** 21 dec = 16 + 4 + 1 = 00010101 bin*
4. Outline a situation where **data compression** would probably NOT be used, as well as a situation where **data compression** is usually needed. *[2 marks]*
   ** data-compression is usually not needed for software stored on a hard-drive, or for normal user data like WP documents*
   ** data-compression is used for video files and graphics files, which are usually very large, especially when these are stored on a web-server for download*
5. Describe a common use of **ROM** that could NOT be accomplished by **RAM**. *[2 marks]*
   ** ROM = Read Only Memory = BIOS = Basic Input Output System*
   ** this is what runs when you BOOT the computer*
   ** in a phone, this might contain the Operating System, which NEVER CHANGES*
   ** ROM is permanent , RAM is temporary*

6. With reference to number bases, explain why one kilometre is equivalent to 1000 metres whereas one kilobyte is equivalent to 1024 bytes. *[2 marks]*

7. Explain how **virtual memory** functions in a **multi-tasking** operating system. *[3 marks]*
   ** When RAM is full, we SWAP part of it onto the HDD - that's Virtual Memory*
   ** This is possible because of Multi-tasking*

8. Assume that an array stores names that are **sorted alphabetically.**

   (a) Explain why keeping the names sorted does NOT improve the efficiency of a **sequential search.** *[2 marks]*
   ** a sequential search starts at the beginning and searches one step at a time this is not different if the file is sorted*

   (b) Describe a searching algorithm that is more efficient than a sequential search, but that can only be used if the data is sorted. *[3 marks]*
   ** a binary search starts in the middle of the list. Then it decides whether the target item is before the middle or after. Then it jumps to the middle of that half and repeats. This only works if the file is sorted.*

9. (a) Outline how an **overflow error** can occur in an **integer variable**. *[1 mark]*
   ** an integer variable is only 32 bits, so any bigger numbers, like 2^33, cannot be stored. This causes an overflow*
   (b) Describe a type of error that can occur in a **floating point variable**, but which cannot occur in an **integer variable.** *[2 marks]*
   ** Rounding error : 1/10 --> .000110011001100...01 stops at 64 bits, it's wrong*

10. This question refers to the **software development life cycle.**
    Explain why the **intended user** must be involved in the **analysis stage,** but probably not involved in the **design stage.** *[2 marks]*
    ** The intended user usually knows a lot about the problem area, and also has needs and wishes for the finished software. Programmers usually don't know much about the problem area. But programmers know a lot more about software design, like data-structures. End-users wouldn't be useful in this area.*

11. Draw a labeled diagram showing the connections between **primary memory**, **cache memory** and the **CPU.** *[3 marks]*

    [CPU]=== Front Side Bus === Cache ===data bus====[RAM]==Disk
    3 Ghz Faster, bigger 1 GigaHertz 64 bits

12. Outline two differences between a **LAN** and a **WAN.** *[2 marks]*
    ** LAN = Local Area Network in one Building (or location)*
    ** WAN = Wide Area Network, not one location*
    ** LAN is owned and controlled by one organization, PRIVATE*
    ** WAN uses public or shared connections, like phone lines*

#13

A digital music player stores a song as a file of numbers (each of which is called a sample) that are converted to a signal for the audio speaker or headphones.

(a) Define the term **analog data.** *[1 mark]*
** data that is measured in continuous, smoothly changing values. For example, sound waves.*
(b) Define the term **digital data.** *[1 mark]*
** data that is measured in discrete intervals, like 5.1, 5.2, 5.3 ... with no values between.*
(c) Identify one example of **analog data** and one example of **digital data** in a digital music player. *[2 marks]*
** The music player stores music files in a digital format, like MP3. This must be transformed into analog data, by and Analog Digital Converter, so that it comes out the headphones as sound waves.*

(d) A CD-quality recording requires 44100 samples for every second of time and each sample is a 16-bit integer (2 bytes).

(i) Outline how the number of kilobytes required for a CD-quality recording of a 3-minute song would be calculated. *[2 marks]*
** 44100 samples x 16 bits (2 bytes per sample) x 180 seconds.*

(ii) State the type of software that could be used to reduce the size of a digital recording. *[1 mark]*
** Compression software*

(e) Discuss one ethical issue created by the availability of digital music recordings on a computer network. *[3 marks]*
** It is so easy to copy digital music in a network that copyright violations are very common.*

#14

Recall that: 18 mod 6 = 0 and 18 mod 7 = 4

Consider the following algorithm, which is written in pseudocode.

```
S = 0

N = 6

loop F from 1 to N-1

     if  (N mod F) = 0  then
          S = S + F
     end if

end loop

output "S = " , S
```

(a) Construct a trace table: *[4 marks]*

F	N mod f	N mod F = 0	S
1	6 mod 1 = 0	true	S = 0 + 1 = 1
2	6 mod 2 = 0	true	S = 1 + 2 = 3
3	6 mod 3 = 0	true	S = 3 + 3 = 6
4	6 mod 4 = 2	false	
5	6 mod 5 = 1	false	

(b) State what will be OUTPUT if we start with N = 12 *[2 marks]*
** It adds up the factors, so 1+2+3+4+6 = 16*

(c) Write a similar algorithm to add up the numbers 1+2+4+8+...+256+512 *[4 marks]*

```
SUM = 0
N = 1
loop while N <= 512
   SUM = SUM + N
   N = N*2
end loop
output "Total = " , SUM
```

#15

Alex is a personal computer (PC) user. She uses her PC for:

1. Playing video games (stored locally)
2. Internet access, especially downloading files
3. Word-processing simple text documents

Alex's PC is 5 years old. The hard-disk is about half full, which is okay,
but Alex finds that all the applications listed above run too slowly.
She wishes to upgrade the hardware, by doing one or more of the following:

- Add an extra hard-disk-drive
- Add more RAM
- Replace the CPU with a faster model

(a) Explain why adding more RAM might speed up one of the applications, clearly identifying which application you are discussing. *[2 marks]*

* RAM (memory) contains RUNNING SOFTWARE
* If the RAM gets full, you are SWAPPING in and out of RAM with HDD (slow)

(b) Explain why replacing the CPU will probably not speed up Internet downloads. *[2 marks]*

* *The slow part of Internet downloads is the slow speed of the network connection. A typical connection speed is something lik 8 MegaBits per sec, whereas a CPU can process something like 2 Ghz x 4 Bytes = 8 GigaByest per sec*

(c) Explain why none of the upgrades listed is likely to speed up word-processing. *[2 marks]*

* *The slow part of word-processing is the typing - about 2 or 3 characters per sec. A faster hard-disk might speed up some loading of extra modules, but that's probably fast enough anyway and doesn't happen very often.*

(d) One possible CPU upgrade would significantly increase the cache memory, but this new CPU runs at the same speed as the old one. Outline the function of cache memory, and state whether or not it is possible that this upgrade would speed up the applications. *[2 marks]*

* *Cache memory is small, temporary memory between the RAM and CPU. The system can load part of a program into cache, so it doesn't need to access RAM for each machine instruction. Yes, this will speed up many applications.*

Alex found out that hardware upgrades are expensive. She is looking for ways to speed up the applications without hardware upgrades.

(e) State the name of a **software utility** which might speed some of the applications (above), and outline how this software utility functions. *[2marks]*

Defragmentation Utitility

Disk compression? No, it makes everything slower

Anti-virus - basically a background process

Game slow-down utilities - no

#16

This question deals with details of programming in pseudocode.

(a) State the output of the following commands: *[2 marks]*

```
A = 100
B = 35
C = A*B

if  A > B  then

     if  A > C  then
        output A
     else if  C > A  then
        output C
     end if

else if  C > B  then
     output C
else
     output B
end if
```

(b) State one example of a **boolean expression** that appears in the algorithm above. *[1 mark]*

* *(A > C)*

(c) Write a single **if..** construct that outputs "equal" if **A** and **B** and **C** are all equal. *[2 marks]*

* *if A=B and B=C then*
  output "Equal"

(e) Construct an algorithm that contains 3 numbers, stored in variables, and outputs the **smallest** of the 3 values. Express your algorithm as a **flowchart**. *[5 marks]*

* *in pseudocode it looks like this:*

```
if A<B then
   if A<C then
      output A
else if B<A then
   if B<C then
      output B
else
   output C
```

********** **HL Extension** **********

#17

A hospital has a large networked computer system. Data in the computer system is confidential.

(a) Identify two ways in which the security of the network within the hospital can be ensured. *[2 marks]*

** Passwords to prevent unauthorized users from access confidential data*
Physical access to administrative machines can be limited by locked doors

(b) Describe how data could be recovered in a case of corruption. *[3 marks]*

** Corruption means data destruction. The hospital needs to make regular (periodic) backups. Then corrupted data can be recovered from the backups.*

Doctors, administrative staff and patients are permitted to access different parts of the data.

(c) Outline how the network administrator can reduce the risk that sensitive patient data is seen by someone other than a doctor. *[2 marks]*

** Encryption with a password that only a doctor knows. But this requires a system where encryption and decryption are automated - the doctor should not need to run a special utility program.*

The hospital uses specialized machines with **embedded microprocessors.**
These machines monitor patients' medical condition –
for example their heart rate, breathing rate and temperature.

(d) Outline why a **dedicated operating system** might be required for a monitoring device, rather than using a general purpose operating system like Windows. *[2 marks]*

** You don't want a critical monitoring device to "crash" due to an OS problem.*
And a monitoring device probably doesn't need very many features that Windows provides.

(e) Explain why an **interrupt driven** system might be more reliable and efficient than a **polling** system for reading signals from the monitoring devices. *[2 marks]*

* Interrupt is a non-regular signal requiring attention
* Polling is a REGULAR CHECK of peripheral devices (inefficient)

(f) Explain why a general purpose operating system like Windows will probably be used in computers that collect and store data from the monitoring devices. *[2 marks]*

** Those machines will probably use standard software like Word-Processors and Spreadsheets, so it's simplest to use a general purpose OS that can run standard software.*

(g) (i) Outline how RFID chips could be used to identify patients. *[1 mark]*

** Embed the chip in an armband, then put the armband on the patient.*

(ii) Outline one reason that RFID identification for patients is desirable. *[1 mark]*

** Patients are not always conscious and/or cannot speak and/or might be confused. Especially in an emergency, it's important to be able to identify the patient quickly.*

********** **HL Extension** **********

#18

This question is about **data-structures.**

(a) (i) Explain why a **2-dimensional array** would NOT be a sensible data-structure for storing employ information that includes : name, telephone, and salary (in Euros). *[2 marks]*

* *In a 2D array, all data entries must be the same type. But this needs both Strings and Numbers. Actually, this is not actually a problem in pseudocode, but in almost any real programming lang.*

(ii) Outline how it would be possible to store employee's name, telephone and salary data in **parallel arrays.** *[2 marks]*

* *Make an array called NAME, an array called PHONE and an array called SALARY. Then for each employee, enter their data in the 3 arrays in the same position.*

(b) A **linked-list** is a **dynamic data-structure** that can be used to store a list of names, as an alternative to using an array.

(i) Outline **one advantage** of using a **dynamic linked-list** rather than a **static array.** *[2 marks]*

* *The length is not fixed, so any amount of data can be added.*

(ii) Outline **one advantage** of using a **static array** instead of a **dynamic linked-list.** *[2 marks]*

* *An array can be accessed using an indes variable, like NAME[X] . So each data access is done in one step. But a linked-list requires a sequential search for each data access.*

A web-browser maintains a list of web-sites that have been visited. It is possible to return to the previous web-site by pressing the [back] button. Pressing the [back] button several times moves back several web-sites.

(c) The web-site addresses for the [back] button could be stored in a **stack** or in a **queue.**

(i) State whether a **stack** or a **queue** would be better for this purpose. *[1 mark]*

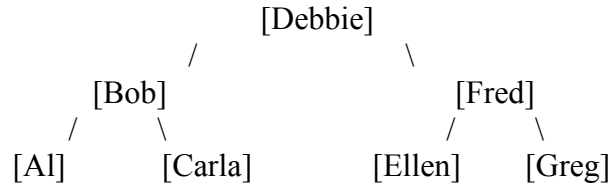
* *a stack is definitely better - previous web-sites are retrieved in reverse order, last in first out*

(ii) State the standard method that would be used to retrieve the web-address from the data-structure when the [back] button is pressed. *[1 mark]*

* *pop()*

A **binary search tree** can be used to store a set of names in alphabetical order.

(d) Draw a binary search tree containing the names: Al, Bob, Carla, Debbie, Ellen, Fred, Greg. *[2 marks]*



(e) (i) Explain how a binary search tree allows names to be retrieved more quickly than a simple sequential search through an array. *[2 marks]*

* *Start searching at the root. Then move to the right-child if the target is larger (after) the root, or move to the left-child if the target is smaller (before). This requires only log2(N) steps for a tree containingN nodes*

(ii) Outline a situation when a search in a binary-search-tree would NOT be more efficient than a sequential search in an array, assuming there are several hundred names in the tree. *[1 mark]*

* *if the nodes are ADDED in alphabetical order, from A to Z, the tree will not be balanced, but rather will be just like a linked-list. Then it requires N steps to search.*