

**SECTION A**

1. Award [1 mark] for each step as follows:

- (a) fetch (an instruction from memory);
- (b) decode (the instruction);
- (c) execute (the instruction);
- (d) store (the result in memory).

2. Award [2 marks] for a complete answer, [1 mark] for a partial answer.

A bus is a pathway through which the processor communicates with other parts of the system. Instructions and data can be sent to/received from RAM, ROM, cache or peripheral devices via a bus.

3. Award [2 marks] for a complete answer, [1 mark] for a partial answer.

A stack is a suitable means for storing subroutine addresses as the most recent address stored (last in) when leaving one subroutine is where the program will want to return (first out) upon completion of the following routine. For example, if subroutine A calls subroutine B which in turn calls subroutine C, the stack would appear as below when inside subroutine C. When C is completed and the top address on the stack is accessed, the address of subroutine B is retrieved – which is the subroutine that called C.

Stack

Return to address B  
Return to address A

4. Award [1 mark] for  $O(n^2)$

5. (a) Award [1 mark] for the following:

0000 1111 0000 0000 0000 0000

(b) Award [1 mark] for  $2^{24}$  or 16777216

(c) Award [1 mark] for each of

(i) 1 0000 1111 0000 0000 0000 0000

(ii) 1F00

6. Award [2 marks] for a clear outline of what defragmentation software does, [1 mark] for a partial/vague answer.  
(As files are saved, re-saved and deleted over time, the free space on the disk can be broken down into quite a number of small sized areas. It is possible that only small parts of new files can be stored in these areas and thus various fragments of files can be located in non-contiguous locations on the disk.) To avoid this, defragmentation software is available that, when run, will reorganize data on the disk such that files are stored intact and the free space is located in a single larger area for the storage of future files.  
(Note that the introduction is needed for the marks, since the question does not ask why the software is needed, but only what it does.)
7. Award [2 marks] for a full answer, [1 mark] for a partial/vague answer. For example:  
A comparison can be made of the system's actual performance and its original goals. During such a review, errors made during the design process can be detected.  
**OR**  
A review can highlight any unexpected problems or benefits that the system has yielded and necessary adjustments, enhancements or additions can be made.
8. Award [1 mark] for each of the following points:  
Internal sorting methods allow a set of data to be sorted by loading all of the data into the primary memory ([1 mark]) and applying the sort algorithm there. External sorting is needed when the data being sorted is too large for the available primary memory space ([1 mark]). Therefore, the sorting takes place by loading subsets of the data into the primary memory to be sorted ([1 mark]) and later emerged with other subsets handled in a similar way ([1 mark]).
9. Award [2 marks] for each, up to a maximum of [4 marks]:
- An interpreter converts a single instruction to machine code and executes it immediately whereas a compiler must convert the entire program to machine code before execution takes place.
  - A compiler creates a separate machine code version of the entire program while an interpreter does not.
  - To execute a compiled program, the compiler does not need to be resident in the primary memory whereas the execution of an interpreted program require that the interpreter be located in the primary memory at all times.
  - With a compiler a program only needs to be translated once (then machine code version is used), whereas with an interpreter it needs to translate every time used.



10. Award [1 mark] for any valid application. For example:
- The program that boots the system and does a system check resides in ROM;
  - Some of the operating system programs can reside in ROM (especially with portable computers);
  - Languages can be placed on a ROM chip;
  - Embedded microprocessors with ROM chips are used in things such as appliances (e.g. VCRs), automobiles, etc.

11. Award [1 mark] for each type of documentation, up to [2 marks] maximum.

- (a) System documentation and user documentation.

Award [2 marks] for a clear reason why both are required, [1 mark] for a vague answer, or only if each type is described but not explained why needed. For example:

- (b) A sample answer such as:

System documentation is needed by programmers or analysts for future modifications whereas user documentation is needed by a (non technical) person to know how to use the system.

System documentation is necessary to show in detail how the system was developed. Good system documentation makes the maintenance and modification of the system easier. Whereas user documentation is essential in that it contains instructions, definitions and procedural information that allows the user to gain maximum benefit from the facilities provided by the system is fine, but a shorter answer such as:

System documentation shows how the system works/was designed. User documentation shows how to use it, would get [1 mark].

12. Award [2 marks] for a complete answer, [1 mark] for a partial/vague answer. For example:
- A computer user may want more than one application running at the same time so that s/he can copy something from a document in one application and paste it into another document created using a second application;
  - A computer user may want to work on a word processing document while a database program is searching for or sorting data;
  - A computer user may want to work on spreadsheets or databases and at the same time be printing something at the same time (in background);
  - etc.

13. Award [1 mark] for the idea of signals or protocols and [1 mark] for the idea of connecting devices, up to [2 marks]. For example:
- The exchange of (predetermined) signals when a connection is established between two modems/devices;
  - A protocol used when communication with (peripheral) devices is taking place;
  - The process by which both the sending and receiving devices in a computer network maintain and coordinate data communications;
  - *etc.*
14. Give [1 mark] for each valid point, up to a maximum of [2 marks].  
Examples include:  
the staff must be trained to use the new hardware (and software);  
some staff may no longer be needed (as the computer filing system lessens the amount of manual work to be done);  
The way in which they do their work may change. (People used to frequently moving about a in the office may now spend long periods sitting in front of a computer.)
15. Give [1 mark] for each of the answers below.
- (a) a scanner;
  - (b) optical character recognition (OCR) system.
16. Award [2 marks] for a complete answer, [1 mark] for a partial/vague answer. For example:
- Interrupts can be generated by various devices or programs in a computer system. Some of these do more important jobs than others. For example, a fire alarm and a printer are given interrupt priorities such that even if the printer currently has access to the C.P.U., an interrupt generated by the fire alarm will override that of the printer, and thus will immediately receive the attention of the C.P.U.;
  - Some tasks require a faster response from the C.P.U. than others, because they are more important/operate faster. For example, a disc drive requiring servicing will be carried out before a printer because it is a faster peripheral.



**SECTION B**

17. Award [2 marks] for the following array of records  
(give [1 mark] if only array stated, [0 marks] for a two-dimensional array):

(a) (i)

LIST

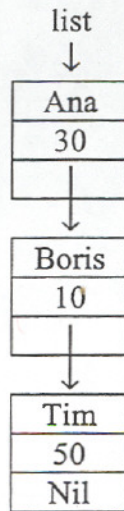
[1]	Ana	30
[2]	Boris	10
[3]	Tim	50

(ii) Award marks as follows:

[1 mark] for showing subscripts/indices;

[1 mark] for showing that all elements of array are of the same type and this type is the record (containing two fields, one of string and the other of numeric data type).

Dynamic – linked list



[1 mark] for showing the external pointer to the first node in the linked list (List)

[1 mark] for showing that each node points to the next node (except the last one which points to nothing (Nil))

## Question 17. continued

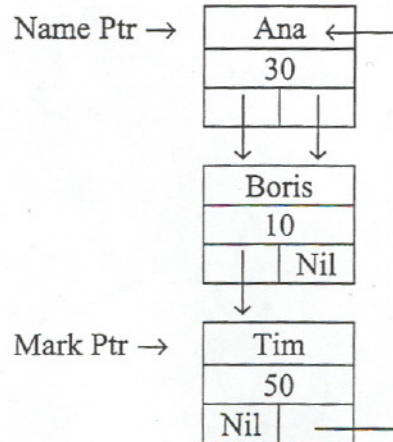
(b) Award marks as follows:

(i) double linked list ([1 mark]);

**OR**

linked list where two (separate) pointers are required ([1 mark]).

(ii)



The 'left' pointer is used for the name, and the 'right' pointer is used for marks.

[1 mark] for showing that two external pointers are needed (Name Ptr and Mark Ptr) to access elements in desired order.

[2 marks] for showing correct links between nodes ([1 mark] for a reasonable but incorrect attempt).

18. (a) Award marks as indicated below; up to [5 marks] max.

COUNT column correct [1 mark]

TEMP column correct [1 mark]

TOTAL column correct [1 mark]

TEMP # 0 column correct [1 mark]

AVERAGE column correct [1 mark]

Line	COUNT	TOTAL	TEMP	TEMP # 0	AVERAGE
1	0	-	-		-
2		0			-
3			15		-
4				true	-
5		15			-
6	1				-
7			7		-
4				true	-
5		22			-
6	2				-
7			23		-
4				true	-
5		45			-
6	3				-
7			9		-
4				true	-
5		54			-
6	4				-
7			0		-
4				false	-
9					13.5



## Question 18. continued

- (b) Award [1 mark] for a suitable value and [1 mark] for the reason; up to [2 marks] max.  
 Example: - 500 (or suitability large negative value) or  
 400 (or suitability large positive value)  
 Explanation: because this could not be a possible reading and so would not cause problems caused by a premature ending of loop.
- (c) Award [1 mark] for the error and [2 marks] for when it occurs ([1 mark] for recognising zero; [1 mark] for first value); up to [3 marks] max.  
 run time error (or division by 0);  
 If the first value entered was 0 (zero) / or the sentinel.

19. (a) Award up to [2 marks] for a full description of each disadvantage; up to [4 marks] max. Award only [1 mark] (each) if the disadvantage is only stated or if an incomplete/vague answer is given.  
 Examples:  
 capital expenditure of a large computer system is enormous;  
 more staff will have to be employed/trained to use the computer, which is time consuming/costly;  
 the computer may be down when information is needed quickly;  
 regular activities may be suspended/disrupted while the change is being made.

[Reward other suitable responses.]

- (b) Award up to [2 marks] for a full explanation of each advantage; up to [4 marks] max. Award only [1 mark] (each) if the advantage is only stated or if an incomplete/vague answer is given.  
 Examples:  
 common features of crimes can be quickly cross-referenced to find similarities, much faster than using manual system;  
 computer can search database of crime details and past convictions to draw up a suspect list, much faster than a manual system;  
 the separate agencies can pool (and cross-reference) information, *i.e.* share database(s) and this cannot be done manually.

[Reward other suitable responses.]

- (c) Award [1 mark] for a suitable point and the second mark for it being due to computer usage.  
 Examples:  
 There might be a fear that civil liberties could be infringed in that computers may store **any** data about people, not just actual crimes, but suspicions, membership of organisations, *etc.* Most countries have laws to protect against this, but the public may still have grave doubts.

With so much information stored, there is more of a possibility of it being misused, *e.g.* hacking, corrupt police officers *etc.*

(Maybe) with more staff using computers in buildings, there will be less police officers on the street leading to lack of public confidence.



20. (a) Award marks for the following table:

A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0

- [1 mark] for both resulting 0s correct (i.e. with 00 and 11)
- [1 mark] for both resulting 1s correct (i.e. with 01 and 10)

(This means that if a candidate simply gives an or table, s/he will gain [1 mark].)

- (b) (i) Award marks for the following table:

P	Q	R	B
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

Award [3 marks] for a complete and correct truth table. (Deduct [1 mark] for each error, e.g. an incorrect value for B in a row, one of the input combinations missing etc.)

Question 20. (b) continued

- (ii) The "neatest" solution is to see from the table that B is dependant on Q and R in the opposite manner from the **XOR** table above:

i.e.  $B = \overline{Q \oplus R}$

This may be derived from the original table by:

$$B = \overline{P} \cdot \overline{Q} \cdot \overline{R} + \overline{P} \cdot Q \cdot R + P \cdot \overline{Q} \cdot \overline{R} + P \cdot Q \cdot R$$

$$\overline{P} \cdot (\overline{Q} \cdot \overline{R} + Q \cdot R) + P \cdot (\overline{Q} \cdot \overline{R} + Q \cdot R)$$

$$(\overline{P} + P) \cdot (\overline{Q} \cdot \overline{R} + Q \cdot R)$$

$$\overline{Q} \cdot \overline{R} + Q \cdot R \quad (\text{which is } \overline{Q \oplus R})$$

$$\overline{Q+R} + Q \cdot R \quad (\overline{Q+R} \text{ is "better" than } \overline{Q} \cdot \overline{R} \text{ because only one (NOR) gate, rather than 3, is required).}$$

Award [1 mark] for correct initial expression for truth table;

Award [1 mark] for some simplification;

Award [1 mark] for one of the final (three) answers above.

- If only given a final answer give [3 marks] if correct, [0 marks] if wrong.
- Allow follow-through from an incorrect answer to the initial statement.
- Simplification may be via Karnaugh map.

	P	$\overline{P}$	
Q	0	0	} $\overline{R}$
	1	1	
$\overline{Q}$	0	0	} R
	1	1	

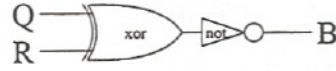
$$Q \cdot R + \overline{Q} \cdot \overline{R} \quad (\text{which is } \overline{Q \oplus R})$$

$$Q \cdot R + \overline{Q+R}$$

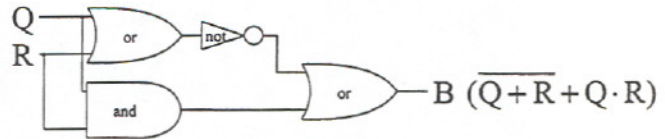
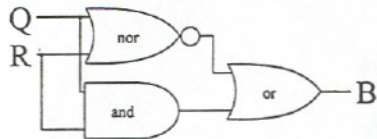


Question 20. (b) continued

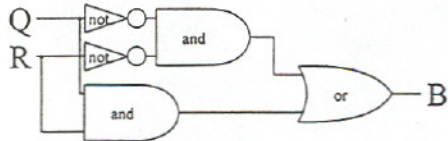
(iii) Any of the following circuits are valid:



$$\overline{(Q \oplus R)}$$



$$\overline{(Q + R)} + Q \cdot R$$



$$\overline{Q} \cdot \overline{R} + Q \cdot R$$

Award [2 marks] for a correct circuit, [1 mark] for a minor error (e.g. omitting a not).

21. (a) Award [2 marks] for a clear outline ([1 mark] for a correct characteristic highlighted, e.g. "speed of operation", but a vague outline), to a maximum of [4 marks] (but only consider two outlines, i.e. if candidate offers three partial answers, then award [2 marks]). Examples include:

- Peripheral devices operate at much slower speeds;
- Data is represented differently in the processor and peripherals, both physically and logically. (Note: these are two separate points, and if both are considered by a candidate, then [4 marks] can be given!);
- Peripherals need additional control information to the processor;
- Processor manipulation is electronic, whereas most peripherals require physical movement (e.g. print head, disc heads etc.);
- etc. (accept valid alternatives).

(b) Award [2 marks] for a clear explanation of a valid task, [1 mark] for a partial answer. Examples include:

- A conversion may be required from parallel in the processor to serial for a peripheral;
- A buffer may be required to store data sent from the processor to a peripheral (or vice versa);
- The address (sent by the processor) of the peripheral needs to be recognised, to open link;
- etc. (accept valid alternatives).

(c) Award marks as follows: (up to [4 marks] maximum)

- [1 mark] for recognising that much data is naturally in analogue form (give a 2nd mark for a suitable example);
- [1 mark] for recognising that if a computer/digital system is going to process this data it needs converting;
- [1 mark] for recognising that in such a system it may be necessary to control a device;
- [1 mark] for recognising that this device may be controlled by analogue signals/ or that the output itself is analogue (e.g. sound);
- [1 mark] for stating that this requires another conversion.

Example:

Many signals that need to be monitored by computer systems exist in analog form (their values are continuously variable). Heat, light, pressure and humidity are some examples. For a digital computer to deal with these types of data, an analog-to-digital converter is needed to convert incoming signals from sensors so that the computer can understand the data in digital form. Likewise, if the computer needs to send a signal to increase heat, pressure etc.; its digital signal must be converted to analog in order for the targeted device to behave accordingly.