X206/701

COMPUTING
ADVANCED HIGHER

Attempt **all** questions in Section I.

Attempt **one** sub-section of Section II.

Part A	Artificial Intelligence	Page 10	Questions 7 to 12
Part B	Computer Architecture	Page 18	Questions 13 to 17
Part C	Computer Networking	Page 23	Questions 18 to 21

For the sub-section chosen, attempt **all** questions.

Read all questions carefully.

Do not write on the question paper.

Write as neatly as possible.

Each section should be answered in a separate answer book.

SQA

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Software Development & Developing a Software Solution

Marks

Answer ALL questions in this section

1. Some people have become increasingly concerned that content about them is available on the World Wide Web. The content accumulates over time and can be spread through the use of social networking sites, blogs and file sharing sites. As a result, an Internet Service Provider (ISP) has appointed a software development company to create a program that can search the Internet for any content about a person and assist in the removal of that content.

(*a*) The ISP gave the software development company a document outlining the features of the planned software. State the name of this type of document. **1**

(*b*) The software development company considered the Computer Misuse Act during its *feasibility study*.

  (i) State the type of feasibility that requires consideration of the Computer Misuse Act. **1**

  (ii) Explain why the implications of the Computer Misuse Act were considered relevant to the removal of content. **2**

(*c*) A systems analysis was performed and an *operational requirements document* (ORD) produced.

  (i) Describe **two** ways that this document could have been used during the **design stage**. **4**

  (ii) Identify a stage, other than design, of the software development process and explain how the ORD could be used during that stage. **1**

  (iii) During the systems analysis a number of software development environments were considered for the project. State **two** features of a software development environment that would influence the selection. **2**

(*d*) The software development company made use of *CASE tools*. State **two** ways in which CASE tools speed up the development of software. **2**

(*e*) *Module testing* was one type of testing performed on the software.

  (i) Describe what is meant by module testing. **1**

  (ii) Name and describe a type of testing that would take place **after** module testing. **2**

[Turn over

SECTION I (continued)

2. *Queues* and *stacks* are data structures used in programs when processing lists.

   (*a*) Describe how a stack and a queue differ in the way that items are added and removed. **2**

   (*b*) A user browsing the World Wide Web can use the back button to return to previous sites.

   The list below shows the sites in the order visited.

http://www.sqa.org.uk/centres.html	Current
http://www.sqa.org.uk/	
http://www.sfeu.org.uk/default.html	
http://www.ltscotland.org.uk/	
http://www.glowscotland.org.uk/index.asp	Oldest

   A stack could be used to store this list of sites.

   (i) Describe the operations on the stack when the back button is used. **2**

   (ii) Explain how this stack could be used to implement the forward function. **2**

   (iii) State **two** errors that can occur during the operation of a stack. **2**

SECTION I (continued)

3. A Health Board is introducing a computerised system to monitor patients. Patients will measure their blood glucose levels and cholesterol levels each morning and will then text the readings to the system using their mobile phones.

The table shows typical data.

Mobile Phone No	Name	Glucose Level mg/dL	Cholesterol Level mg/dL
07545454054	Mina	85	120
07646565656	Aaron	70	210
07589555845	Louis	88	195

(*a*) The system uses a record structure to store **each** patient's data.

   (i) Define a suitable record structure for the data to be stored. **3**

   (ii) The system is designed for a maximum of three thousand patients. Define a variable based on the record structure that could store the data for up to three thousand patients. **3**

(*b*) The system creates a data file containing the mobile phone number and name of any patients that have a glucose level under 75 and whose cholesterol level is over 200.

Write, **using detailed pseudocode**, an algorithm to create a data file of these patients. Your answer should refer to the variable defined in (*a*)(ii). **6**

(*c*) Corrective maintenance is required because there is an error in the system. Describe **one** feature of a software development environment that could be used to locate an error. **1**

[Turn over

SECTION I (continued)

4. Here is a section of code from a sort algorithm.

```
1.        for counter = 1 to length of unsorted list – 1
2.            if array[counter] > array[counter + 1] then
3.                temp = array [counter]
4.                array[counter] = array[counter + 1]
5.                array[counter + 1] = temp
6.                swap = true
7.            end if
8.        end for
```

(*a*)　(i)　State the name of the sort.　　　　　　　　　　　　　　　**1**

　　　(ii)　State the order into which the complete algorithm would sort a list.　　**1**

　　　(iii)　Explain the purpose of line 2 in this type of sort.　　　　　　**2**

　　　(iv)　A variable **swap** is used at line 6.

　　　　　　A　Explain why this variable is assigned the value **true** at line 6.　**2**
　　　　　　B　Explain how this variable would be used in the complete algorithm.　**1**

(*b*)　Programmers use *trace tables* during the software development process.

　　　(i)　Describe the purpose of a trace table.　　　　　　　　　**2**

　　　(ii)　An array contains the following values.

Index	1	2	3	4
Array value	15	30	25	42

The array has been used with the section of code shown above to partially complete a trace table. State the values of the variables that are missing from the trace table at positions A, B, C and D below.　　　　　**4**

Algorithm Line	counter	array[counter]>array[counter+1]	temp	array[counter]	array[counter+1]	swap
1	1					
2		False				
1	2					
2		True				
3			A			
4				B		
5					C	
6						D

SECTION I (continued)

5. A computer program is required to search the following list.

4	9	11	15	28	42	45

(*a*) Describe how a *linear search* locates an item that is in the list. **1**

(*b*) An item in the list could also be located using the *binary search* algorithm.

(i) State the number of comparisons required to locate the number 42 in the above list. **1**

(ii) Here is an incomplete binary search algorithm.

```
1.      set lower to lowest index value
2.      set upper to highest index value
3.      loop
4.          set middle to (lower+upper) div 2
5.          if search_item > list[middle] then

6.              ...............................................
7.          else

8.              ...............................................
9.          end if
10.     until search_item = list[middle] or lower>upper
```

A   State the line missing at line 6. **2**

B   State the line missing at line 8. **2**

[Turn over

SECTION I (continued)

6. Programming languages have developed from low level, such as assembly language, to high level, such as procedural languages.

   (*a*) Programmers define how their program will store data at the start of a program. Describe how low level languages and high level languages **differ** in the use of data types.

   2

   (*b*) Fourth-generation languages were part of the trend in the development of programming languages. Describe what is meant by a fourth-generation language.

   2

   (60)

[END OF SECTION I]

SECTION II

Attempt ONE sub-section of Section II

For the sub-section chosen, attempt *all* questions.
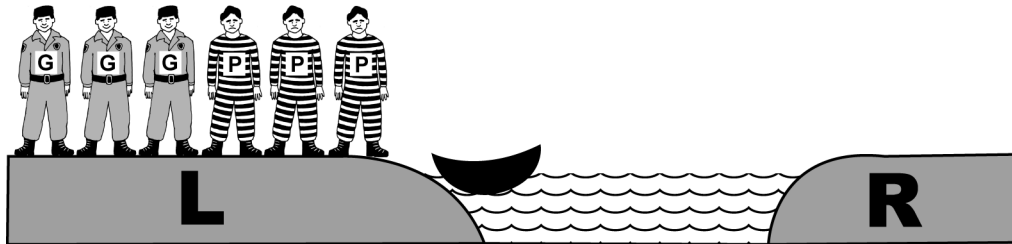
[Turn over

SECTION II

Part A — Artificial Intelligence

Answer ALL questions in this part.

7. A group of 6 pupils is taking part in a team challenge event. In one of the challenges, they are divided into 3 guards and 3 prisoners, and they find themselves on the left bank of a river. There is a canoe which can carry only 1 or 2 people across the river at one time.

The *goal state* is for all 6 pupils and the canoe to be on the right bank of the river. The problem is to find a sequence of moves which achieves this goal without ever leaving the guards outnumbered by the prisoners on either bank of the river.

One possible intermediate stage might be:

- 3 guards and 1 prisoner on the left bank
- 0 guards and 2 prisoners on the right bank
- the canoe at the left bank.
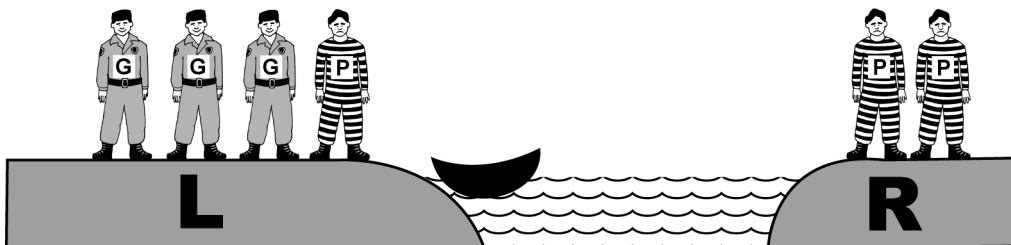
The pupils decide to use the AI techniques of *symbolic representation* and *search trees* to work out the best way to get across the river.

A possible symbolic representation of the intermediate state above would be [(3,1),(0,2),L], where (3,1) represents the number of guards and prisoners on the left bank, (0,2) represents the number of guards and prisoners on the right bank, and L indicates that the canoe is at the left bank.

(*a*) The start state can be represented as [(3,3),(0,0),L].

Using the same symbolic representation, represent the goal state. **1**

SECTION II

Part A — Artificial Intelligence (continued)

7.   **(continued)**

(*b*)   There are **five** possible first moves which need to be considered, although some of these may lead to invalid states.

  1.   1 guard and 1 prisoner cross from L to R in the canoe

  2.   1 guard crosses alone from L to R in the canoe

  3.   2 guards cross from L to R in the canoe

  4.   1 prisoner crosses alone from L to R in the canoe

  5.   2 prisoners cross from L to R in the canoe

  (i)   Draw a *search tree* showing these five moves and the resultant states.   **3**

  (ii)   Identify **three** of these possible first moves which do not need to be considered further when searching for a solution, giving a reason for each of your choices.   **3**

  (iii)   Considering only the two remaining nodes, extend the search tree to the next level, showing only branches which do not lead back to the initial state.   **3**

[Turn over

SECTION II

Part A — Artificial Intelligence (continued)

8. A tree can be searched using the *hill-climbing* algorithm.

Consider the following incomplete version of this algorithm.

1. current_state=initial_state
2. repeat
3.   get successors of current_state
4.   calculate evaluation function for each successor
5.   select successor with highest evaluation function
6.   if evaluation function of chosen successor > evaluation function of current_state, make this the new current_state

7. until current_state = goal_state or ....

(*a*) State the other possible terminating condition which would complete the final line of the algorithm. **1**

(*b*) The following *search tree* represents the *state space* for a problem. An *evaluation function* has been calculated for each *node*, with lower values indicating more promising states. The *start state* has value 100, and any *goal state* has value 0.
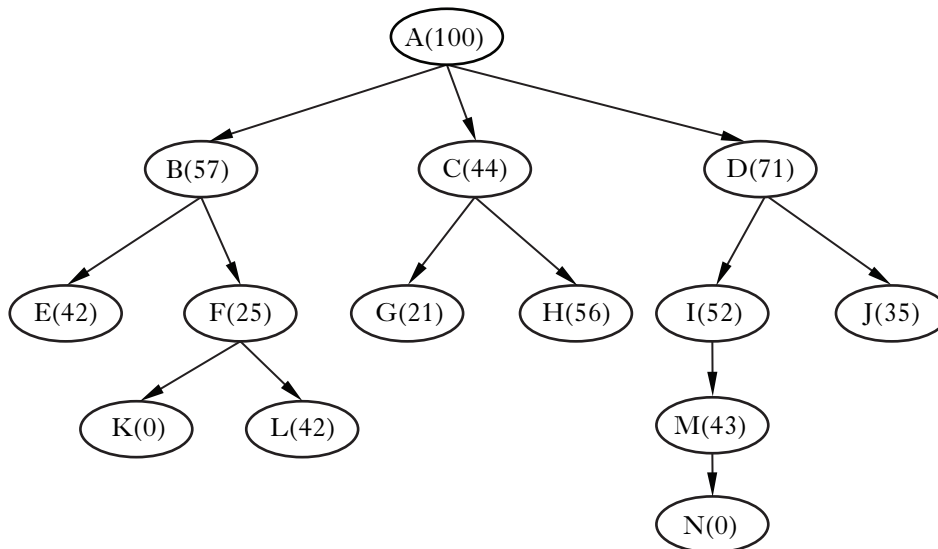
(i) Identify the changes required in steps 5 and 6 of the algorithm above if it is to be applied successfully to this tree. **2**

(ii) Name one other *heuristic* search algorithm which could be used to search this tree. **1**

(*c*) A tree can be searched using either a heuristic search algorithm such as hill-climbing, or by an exhaustive search algorithm such as breadth-first.
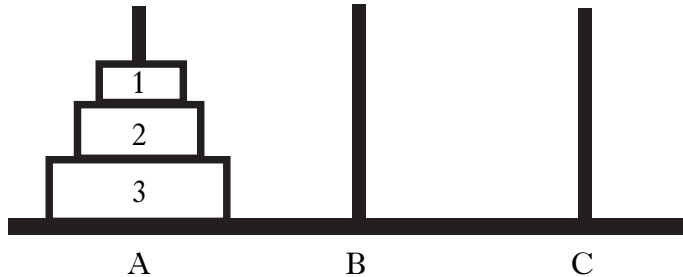
(i) Describe one **advantage** of heuristic search compared to exhaustive search. **2**

(ii) Describe one **disadvantage** of heuristic search compared to exhaustive search. **2**

SECTION II

Part A — Artificial Intelligence (continued)

9. A simple 3 ring version of the Tower of Hanoi puzzle can be represented using *blocks world notation*. For example, the starting position:

can be represented as: [on(3,A), on(2,3), on (1,2), clear(1), clear(B), clear(C)]

A ring may be moved from one peg to another, but a larger ring may not be placed on a smaller ring.

(*a*) Explain why the position [on(1,C), on(2,1) on(3,B), clear(A), clear(3), clear(2)] is not allowed. **1**

(*b*) An automatic system is being designed which uses a robot arm to move rings from one peg to another. The programmer decides that the operation "move ring 2 from peg B to peg C" can be written formally as move (2,B,C).

  (i) Write down, in this formal notation, the **two** alternative first operations from the starting position shown above. **2**

  (ii) State **two** reasons why *Prolog* would be a suitable language for programming this system. **2**

[Turn over

SECTION II

Part A — Artificial Intelligence (continued)

10. The following *frame* represents some information about eating places.

Eating Place	
subclass:	building
type:	*sit-in
food-type:	*full meals
licensed:	*yes

Note: *indicates a *default value*.

(*a*) (i) Create four more frames to represent the following information.

"Eating places can be classified as sit-in or takeaway. Takeaways are not usually licensed. Takeaways sell fast-food. Sit-ins have tables and chairs, and serve full meals. Tom's Tower is a takeaway. The Boat is a sit-in restaurant which does not have a license." **4**

(ii) State any property which would be *inherited* by Tom's Tower, and explain why this is so. **2**

(*b*) Describe clearly the difference between a *sub-class* and an *instance*. **2**

(*c*) The names of some of the sit-in restaurants in town are stored in a Prolog *list* [the_boat, eastern_star, chevy_nova, rudha_reidh].

(i) Write down the *tail* of this list, using correct notation. **2**

(ii) List membership is defined using two clauses:

1   member(M,[M|Tail]).

2   member(M,[Head|Tail]) IF member (M, Tail).

Explain how Prolog would use *recursion* to evaluate the following query:

?member(eastern_star,[the_boat, eastern_star, chevy_nova, rudha_reidh]). **4**

SECTION II

Part A — Artificial Intelligence (continued)

11. The following rules are included in a *forward chaining* medical *expert system*.

> rule 1: IF symptom is fever AND age of patient > 70 THEN hospital care is required
>
> rule 2: IF symptom is fever AND patient has pains in stomach and legs THEN diagnosis may be influenza
>
> rule 3: IF body temperature > 38 AND patient's skin colour is red THEN symptom is fever

During a consultation the doctor has entered the following facts, which are stored in *working memory*.

- Body temperature is 39·7 °C
- Patient's skin colour is red
- Patient has pains in stomach and legs
- Age of patient is 73.

The forward-chaining system uses these facts and rules to diagnose the patient's condition and recommend treatment.

(*a*)   (i)   State any new facts added to working memory on a first pass through the rules.   **1**

    (ii)   State any new facts added to working memory on a second pass.   **2**

(*b*)   Explain why *conflict resolution* may be needed in a forward chaining system.   **1**

(*c*)   When the system is being evaluated, the *domain expert* suggests that the rules need to be modified, as rule 2 is only true in 50% of cases.

    (i)   Rewrite rule 2 to include this new information.   **1**

    (ii)   In addition, the domain expert suggests that rule 1 is only true in 90% of cases, and rule 3 is true in around 75% of cases. Calculate the certainty that hospital care is required for the current patient.   **2**

(*d*)   The system currently uses a *menu-based interface*, which allows the user to select options in response to questions generated by the system. A study is being undertaken to explore the possibility of converting the system to accept *natural language input*.

    (i)   Describe **two** aspects of this proposal which should be considered during the *feasibility study*.   **2**

    (ii)   The first stage of processing of the natural language input is *syntactic analysis*. Name and describe the next **two** types of analysis required to process the natural language input to the system.   **4**

    (iii)   Explain why the increasing availability of cheap computer memory has made natural language interfaces much more feasible for commercial applications.   **2**
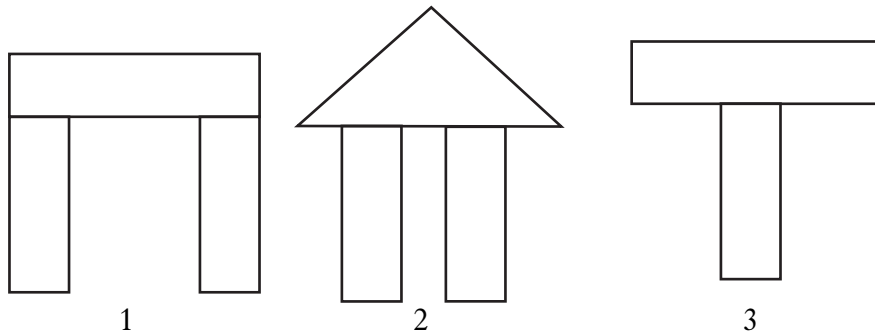
[Turn over

SECTION II

Part A — Artificial Intelligence (continued)

12. An early attempt at developing a program which could learn was known as Winston's Arch. The aim of the program was to learn how to recognise whether or not a group of blocks would form an arch.

The following three diagrams are typical of the type of input that was used to test the program.

1   2   3

(*a*)   Winston's Arch used a form of machine learning known as *inductive learning*.

Explain briefly how inductive learning could be used to develop machine understanding of the concept of an arch. You may wish to refer to the three diagrams above.   **3**

(*b*)   A modern version of Winston's Arch uses 3-D images like this as input.
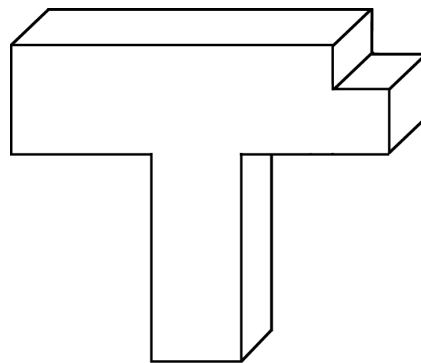
  (i)   The system makes use of the *Waltz algorithm* during the process of interpreting the 2-D representation of a 3-D shape. Apply the Waltz algorithm to this shape.   **3**

 (ii)   Explain the role of *recursion* in the application of the Waltz algorithm.   **1**

(iii)   Sketch a possible arch that could **not** be analysed by the Waltz algorithm, and justify your choice of example.   **1**

(60)

[*END OF SECTION II—PART A*]

[Turn over for Section II Part B on *Page eighteen*

SECTION II

Part B — Computer Architecture

Answer ALL questions in this part.

13. Mediatrain is a company which uses a high performance computer system to produce multimedia training projects. The computer system has a PowerPC superscalar processor which has thirty two 64-bit general purpose registers.

(*a*) The PowerPC is an example of a *RISC* processor. RISC processors have a large number of general purpose registers.

Name **three other** features of a *RISC* processor that distinguish it from a *CISC* processor. **3**

(*b*) *Registers* are an important element in the internal memory structure of a computer system. Explain the function of the following registers.

(i) The Memory Address Register (*MAR*)

(ii) The Instruction Register (*IR*) **2**

(*c*) Explain the benefit to the PowerPC processor of having so many general purpose registers. **2**

(*d*) Most of the instructions in the PowerPC processor instruction set have an *op-code* and an *operand*.

Describe the function of the op-code and the operand. **2**

(*e*) *Superscalar* processing involves the use of multiple pipelines.

State a feature of the PowerPC processor which makes it suited to superscalar processing. Justify your answer. **4**

(*f*) *Branch instructions* can cause a problem for processors which use *pipelines*. *Branch prediction* can reduce this problem.

Describe how branch prediction operates. **3**

(*g*) The PowerPC processor makes use of *Single Instruction Multiple Data* (*SIMD*) instructions.

Explain how the use of SIMD instructions **improves performance**, using a suitable multimedia example. **3**

SECTION II

Part B — Computer Architecture (continued)

14. Admedia is a company which uses a computer system to produce adverts for television. The company needs to upgrade its system because the slow access to main memory reduces performance.

    The upgraded system makes use of *memory interleaving* to overcome this problem.

    (*a*) Describe how memory interleaving operates. **3**

    (*b*) Memory interleaving is often more effective when used for writing to main memory rather than reading from main memory.

    Explain why memory interleaving **can** be used effectively to read data from the dedicated video RAM. **3**

15. Emma replaces her older Arbitron04 computer with the latest McI09 system. Some of the details of the cache structure on both systems are shown in this table.

	Arbitron04	**McI09**
Level 1 cache	32 kilobytes	64 kilobytes
Level 2 cache	256 kilobytes, located on the motherboard	1 megabyte built into the processor module

    (*a*) State which type of memory chips would be the best choice for Level 2 cache on the Arbitron to ensure maximum performance. Justify your choice. **2**

    (*b*) Explain how the cache structure on the McI09 will lead to improved performance. **4**

    (*c*) When using the Arbitron04, slow data transfers between peripherals and main memory were reducing system performance by taking up large amounts of the processor's time.

    Describe **one technique** that could improve the speed of data transfer. **3**

    [Turn over

SECTION II

Part B — Computer Architecture (continued)

16. Ewan, a website designer, has web authoring, graphics editing and video editing software applications and their associated data files in his computer's main memory at the same time. The operating system uses *variable memory partitioning* to manage the demands this makes on memory.

(*a*) Explain what is meant by the term *variable memory partitioning.* **1**

(*b*) Variable memory partitioning can lead to fragmentation of memory.

Explain how the *worst fit* algorithm attempts to limit fragmentation of memory. **3**

(*c*) Ewan sets up a hierarchical directory structure to manage his large number of data files.

The operating system maintains a *logical view* and a *physical view* of each file.

(i) Describe the difference between the logical view and the physical view of a file. **2**

(ii) When Ewan clicks on the icon of a file to open it, the operating system has to map the logical view onto the physical view of the file.

In the example below, video_file1 is divided into clusters each of which has a pointer to the next cluster. The last cluster in each file is marked by EOF.

Using the tables below, list the clusters that make up video_file1.

Filename	First cluster
graphic_file1	Cluster 5
video_file1	Cluster 7

Cluster	Pointer
1	
2	6
3	
4	EOF
5	8
6	4
7	2
8	10
9	EOF
10	9

2

(iii) Explain why the pointers in (*c*)(ii) would **not** be needed if *contiguous allocation* were used to store the file. **2**

SECTION II

Part B — Computer Architecture (continued)

16. (continued)

(*d*) The operating system stores the following *file attributes* when a video file is saved.

Attribute	Explanation
Name	the name and file extension
Size	the size of the file in bytes
Location	pointer to the index block
Creation	time and date when the file was created
Modification	time and date of most recent modification

Explain how **two** of these file attributes could be used for security purposes. **2**

(*e*) The operating system supports Ewan's web authoring, graphics editing and video editing software applications by providing a range of *services* on which they can call.

  (i) State **two** of these services. **2**

  (ii) Explain an advantage to the **user** of one of the services provided by the operating system by referring to your answer to (*e*)(i). **2**

  (iii) Explain an advantage to an **application software developer** of one of the services provided by the operating system by referring to your answer to (*e*)(i). **2**

17. A travel agent agrees to beta test a new operating system, called Siesta, on her computer system.

(*a*) Describe the travel agent's role in beta testing. **2**

(*b*) Siesta offers the user a choice of locating a spreadsheet file by clicking on a series of icons representing the directories in the hierarchy or by entering a text command.

  (i) Compare the demands made on the processor by each of these methods of locating a spreadsheet file. **4**

  (ii) Explain the terms *syntax* and *semantics* by referring to this context. **2**

(60)

[*END OF SECTION II — PART B*]

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SECTION II

Part C — Computer Networking

Answer ALL questions in this part.

18. A university is intending to make access to its intranet available to students who live in each of its 9 halls of residence.

The university has a class B IP network. The first two octets of the network's IP addresses are 163.123.

(*a*) Calculate the number of hosts that can exist on the university network.　　**2**

(*b*) The intention is that each of the halls of residence will have its own network. This will be achieved using *subnetting*. Subnetting is implemented using *subnet masks*.

　(i) Explain why subnetting should be used in this situation.　　**2**

　(ii) Calculate the value of the subnet mask that would be used to allocate 1022 hosts to each subnet. State your answer in dotted decimal notation.　　**3**

　(iii) Calculate the number of subnets that will be provided using the subnet mask calculated in part (ii) above.　　**1**

(*c*) A post-graduate electronic engineer in the university is collaborating with a professor in America whom he has never met in person. They send each other confidential files as e-mail attachments. They intend to use *public key encryption* to transfer files.

　(i) Explain why public key encryption is more appropriate than conventional encryption in this situation.　　**1**

　(ii) Describe the steps required to implement public key encryption.　　**4**

　(iii) Describe a further step that they may take to increase security.　　**2**

(*d*) The university has experienced attempts to disrupt the smooth running of its network.

　(i) One attempt was successful in having a web page, stored on an alternate server, displayed as the university's intranet home page. The normal home page remained unchanged on the university's webserver. Describe how this could have been achieved.　　**2**

　　Recently a denial of service attack was successful in making a server's operating system crash.

　(ii) Name a type of denial of service attack that may have been used.　　**1**

　(iii) On this occasion both the system files and all the data from the server were corrupted. In order to rebuild the server the network manager had to use four backup tapes. The four backup tapes, in chronological order, were named A, B, C and D. Which types of backup must A, C and D have been?　　**3**

SECTION II

Part C — Computer Networking (continued)

19. Alex is a home Internet user. His communications setup uses *PPP*.

(*a*)   (i)   Describe the functions of PPP.   **2**

(ii)   State the layer of the *OSI model* at which PPP operates.   **1**

(*b*)   PPP was developed as a replacement for *SLIP*. State **three** improvements that make PPP preferable to SLIP.   **3**

(*c*)   Alex regularly uses e-mail. The e-mail application uses *SMTP* to send e-mails to the e-mail server.

(i)   State **two** reasons why SMTP sends e-mail to a server and not directly to the intended recipient.   **2**

(ii)   The SMTP dialogue between the client and server during the sending of an e-mail is shown in the table below.

	Client	Opens TCP connection
	Server	220 mailserver.com
1	Client	
	Server	250 hello clientdomain.com
	Client	MAIL FROM: sender@clientdomain.com
2	Server	
	Client	RCPT TO: john@server.com
	Server	250 accepted
	Client	DATA
	Server	354 end data with "."
	Client	Subject: Seasonal greetings From: sender@clientdomain.com To: john@server.com Hope you have a great time.
	Server	250 ok message queued for delivery
3	Client	
	Server	221 Bye

Write the contents of each of the missing lines numbered 1, 2 and 3.   **3**

(*d*)   The *TCP/IP* model can be mapped to OSI model layers. Draw a diagram that clearly shows the relationship between the different layers of these two models.   **3**

SECTION II

Part C — Computer Networking (continued)

20. A web developer has been working on a page which displays a list of helpful *plug-ins* that clients browsing his websites may require.

The current state of the page is:

Web Browser Plug-ins
Plug-ins Below is a list of links to the most widely used web browser plug-ins. Adobe Acrobat Reader

An incomplete listing of the code written so far is shown below.

```
    <html>
    <title>Web Browser Plug-ins</title>
    <body>
1
    <p>
    Below is a list of links to the most widely used web browser plug-ins.
    </p>
2
    </body>
    </html>
```

(*a*)　(i)　The section header "Plug-ins" is to be displayed as red text. Write a line of *HTML* code that could be entered at location 1 in the code above to display the section header as shown in red text. **2**

　　　(ii)　The Adobe Acrobat download is available at www.adobe.com/downloads/. Write a line of HTML code that could be entered at location 2 in the code above to display the link as shown. **2**

(*b*)　The Adobe Acrobat plug-in allows a browser to display *portable documents*.

　　　(i)　State **two** other functions which plug-ins may add to browsers and name a current example of each. **4**

　　　(ii)　Video sharing and social networking websites such as Bebo, YouTube and Facebook make extensive use of plug-ins.

　　　　　Describe **two** possible social implications of using these sites. **4**

[Turn over

SECTION II

Part C — Computer Networking (continued)

21. Aneeka is the owner of a small computer shop.

(*a*) Aneeka has decided to offer a *teleconferencing* advice and support service to customers who have purchased computer systems from her. As the communications configuration of her clients will differ, this service must be able to be implemented using a webcam, instant messaging software and a minimum network connection speed of 56 Kbps.

    (i) Explain why a similar configuration would not be suitable for a multi-national company wishing to use teleconferencing with many participants in different countries. **2**

    (ii) Describe the hardware and software improvements that would be required to deliver a suitable system for this multi-national company. **2**

(*b*) All of the items delivered to the shop from its suppliers are tracked using transmitters embedded in the packaging. These transmitters use wireless technology based on *Ultrawideband* (UWB).

    (i) State **two** characteristics of UWB which would make it suitable for use in a goods tracking system. **2**

HiperLAN2 is a wireless communication method.

    (ii) At which frequency and bandwidth does HiperLAN2 operate? **2**

    (iii) Name another wireless communication method that is in direct competition with HiperLAN2. **1**

(*c*) Aneeka wants to improve the efficiency of purchasing goods. Software is being developed that allows goods to be identified and paid for at the point of sale without the need to empty the shopping basket.

    (i) Explain the difference between module and component testing by giving examples, in relation to this software, of functions that might be tested at each of these two stages. **2**

    (ii) Describe how beta testing of this software may be carried out. **2**

(60)

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