X206/13/01

NATIONAL QUALIFICATIONS 2012

THURSDAY, 31 MAY
9.00 AM – 11.30 AM

COMPUTING
ADVANCED HIGHER

Attempt **all** questions in Section I.

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

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.

LI X206/13/01 6/1810

SECTION I

Marks

Software Development & Developing a Software Solution

Answer ALL questions in this section.

1. A mobile phone company will launch its new smartphone in six months and will introduce multiplayer gaming. These multiplayer games will allow users to interact with other smartphone users in the same gaming environment. The smartphone will allow users to:

- connect with other smartphones
- choose their character in the game
- interact and communicate with other players during the game.

The mobile phone company approaches GeekySoft, a games development company, to develop the game.

(*a*) GeekySoft begins by considering whether the capabilities of the smartphone can deliver realistic game play.

(i) State the **type** of feasibility being considered. **1**

(ii) State **one** characteristic of the smartphone that might be considered when investigating this type of feasibility. Explain why it would be considered. **2**

(*b*) GeekySoft appoints a systems analyst to perform a system investigation. This results in an *operational requirements document* (*ORD*).

(i) The ORD specifies the *functional requirements*. Explain what is meant by the functional requirements. **1**

(ii) State **one** reason why functional requirements would be referred to **after** the analysis stage. **1**

(iii) The ORD also includes the data requirements. Describe **one** other way in which the contents of the ORD clarify details of the proposed software. **1**

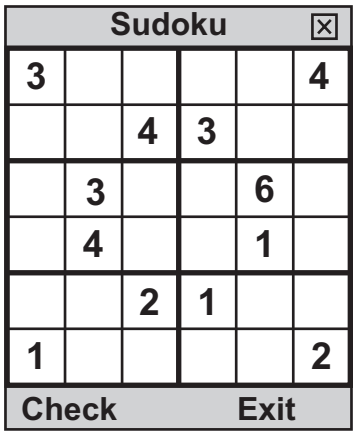
(*c*) Effective project management involves identifying sub-tasks. State **two** other techniques used in project management that track or optimise progress. **2**

(*d*) During implementation, the programmers can identify errors in the code using a *trace table*.

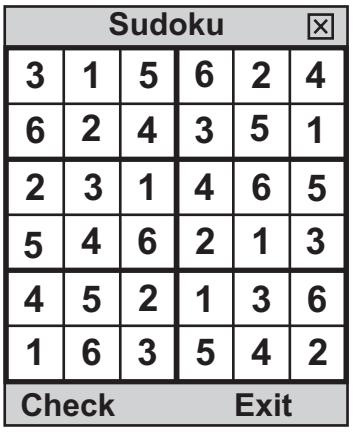
(i) Describe how a programmer would complete a trace table. **2**

(ii) Name and describe **one** other method of locating errors in the code. **2**

2. An application for a website has been created to play a simplified version of Sudoku. In this version of the puzzle each 2 × 3 minigrid, row and column should contain only one instance of the digits one to six. The diagram below shows the initial state of the puzzle and the solution.



Initial State



Solution

(*a*) A 2-D array is used to store the state of the puzzle as entered by the player.

(i) Explain what is meant by a 2-D array. **2**

(ii) Declare a 2-D array called **puzzle_state** that can hold the state of the puzzle. **2**

(*b*) When the player completes the Sudoku grid they can select the **Check** option. This option will count the number of incorrect squares currently in the puzzle. This is achieved by comparing the player's responses held in **puzzle_state** with the solution held in another 2-D array called **solution**. An example is shown below.

3	6	5	1	2	4
1	2	4	3	5	6
6	3	1	4	6	5
5	4	6	2	1	3
4	5	2	1	3	6
1	6	3	5	4	2

puzzle_state

3	1	5	6	2	4
6	2	4	3	5	1
2	3	1	4	6	5
5	4	6	2	1	3
4	5	2	1	3	6
1	6	3	5	4	2

solution

Write an algorithm to count the number of incorrect squares that the player has in the puzzle. **4**

(*c*) The algorithm to count incorrect squares formed part of a subroutine. This subroutine was then tested. Describe **one** other type of testing that could have taken place before an executable version was put on the website. **2**

3. A social networking website requires information about its members. The table below shows a sample of the information stored.

Surname	Forename	Username	Password
Walker	Andrew	andypandy	5654
Anderson	Eilish	ellie34	1457
Khan	Ganesh	ganeshk	1457
Anderson	Kevin	kev67	4789
Gallagher	Paul	pg88	2564
Anderson	Shona	shaza	7312
Khan	Zahra	zarahk	1958

(*a*) A *record* data structure is used for the members' details.

```
Record type memberDetails
        Surname:string
        Forename:string
        Username:string
        Password:integer
End record
```

Define a variable based on the record structure that could store the data for up to five million members. **2**

(*b*) The program uses a linear search to find a **Username** when a member logs on. Explain why a linear search causes different users to experience different response times when logging on. **2**

(*c*) It is decided to change to a *binary search* that asks for a **Username**. State **two** reasons why **Password** is unsuitable for a binary search of the data as currently stored. It may be useful to refer to the information in the table above. **2**

(*d*) Use pseudocode to write a binary search algorithm that asks for a **Username** and then finds the position of that username in the five million members. **6**

[Turn over for Question four on *Page six*

4. An object-oriented language is used to create a class called **Queue**. The following line of code initialises a queue called FirstQ:

```
Queue FirstQ=new Queue()
```

The class definition includes the following methods:

Method Name	Description
addtoback	Adds an object to the rear of the queue
remove	Removes an object from the front of the queue
isempty	Returns true if the queue is empty

(*a*) Other than methods, describe what else would be defined in a class. **2**

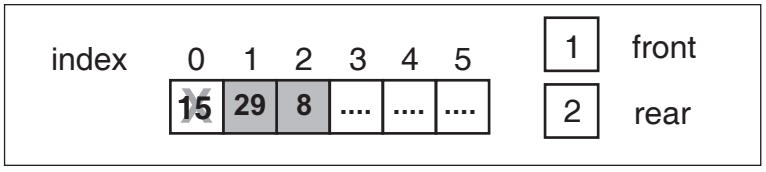
(*b*) The class uses a 1-D array with six elements to hold the contents of the queue and the variables **front** and **rear** to hold the positions of the item at the front and rear of the queue.

The following lines of code are executed:

```
FirstQ.addtoback(15)
FirstQ.addtoback(29)
FirstQ.remove
FirstQ.addtoback(8)
```

The following diagram shows that 29 and 8 are in the queue. The number 15 is still present in the 1-D array but is not in the queue.

FirstQ



(i) State what happens to the variables **front** and **rear** when a number is removed from the queue. **2**

(ii) The state of FirstQ shown above is changed by executing these additional lines of code:

```
FirstQ.addtoback(11)
FirstQ.remove
FirstQ.addtoback(9)
```

Draw a diagram that shows the new state of FirstQ. **3**

(*c*) (i) Describe the problem that will arise as items continue to be added and removed from FirstQ. **2**

(ii) Describe how the problem in (*c*)(i) could be solved. **1**

4. (continued)

(*d*) An operating system uses the Queue class to keep track of processes. However, another type of queue is also required that has additional features not found in the Queue class.

(i) Explain how an object-oriented language would be used to implement the new type of queue. **2**

(ii) Describe **one** benefit of implementing the new queue using an object-oriented language. **2**

[Turn over

5. An exam has eight questions each worth 20 marks. An example of a candidate's eight marks for the eight questions is shown below.

15	12	18	16	5	19	15	14

A candidate's overall score for the exam is calculated by totalling their **best** five questions. The candidate's best five questions could be identified by sorting the list into descending order. The best five questions would then be in the first five positions in the list.

A programmer has been asked to write a module to calculate the overall total. The programmer considers using the *simple sort* or the *bubble sort* algorithms.

(*a*) (i) Describe how the *simple sort* rearranges the list into descending order. **2**

(ii) After the first pass using the *simple sort* the list is:

19	12	15	16	5	18	15	14

Write down the list after each of the next two passes through the list. **2**

(iii) The simple sort will require fives passes through the list to find the five highest question totals.

State the number of comparisons required by the simple sort. Explain your answer. **2**

(*b*) (i) After the first pass using the bubble sort the list is:

15	18	16	12	19	15	14	5

Write down the list after the next pass. **1**

(ii) State the maximum number of passes required by the bubble sort to place the best five question totals in the first five positions. Explain your answer. **2**

(*c*) A candidate scores these marks:

19	19	17	16	14	14	13	11

The simple sort of this list will **still** require five passes.

(i) State the number of passes required by the bubble sort for this list. **1**

(ii) Explain the feature of the bubble sort that makes it more efficient for this list. **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

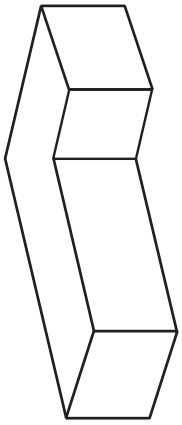
SECTION II

Marks

Part A — Artificial Intelligence

Answer ALL questions in this section.

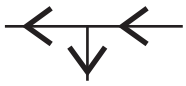
6. The *Waltz algorithm* is used during the interpretation of a 2-D representation of a 3-D shape. For example, the following is a representation of a foam infill for a car seat arm rest.



(*a*) Each line in the 2-D representation can be labelled as having one of three states; one of these is a boundary line. Name the other **two** possible states. **2**

(*b*) In the Waltz algorithm, eighteen legal "junctions" are defined.

From the three junctions below, identify the one that is **not** a legal junction.

(i) 

(ii) 

(iii) 

1

(*c*) Apply the Waltz algorithm to the representation of the foam infill above. You will need to sketch the shape in your answer book. **3**

SECTION II

Marks

Part A — Artificial Intelligence (continued)

7. The earliest recorded computer program that attempted to carry out *natural language understanding* was written by a student in 1964.

(*a*) Name the stage of natural language understanding which follows *syntactic analysis* and *semantic analysis*. **1**

(*b*) A grammatically correct sentence will normally have at least one *noun phrase* and one *verb phrase*.

One form of a noun phrase is a determiner and a noun. Another could be a pronoun. State **one** other form of a noun phrase. **1**

(*c*) *Syntactic analysis* will identify the sentence below as grammatically correct.

The car drove the man.

(i) Construct a *parse tree* for "The car drove the man." **3**

(ii) Explain the role of search in the parsing process. **2**

(iii) Explain why both a syntactic analysis and a semantic analysis are needed as part of natural language understanding.

You may use this example to illustrate your answer. **2**

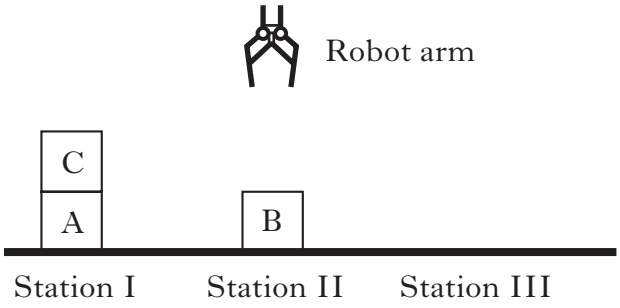
(*d*) State **one** example of a word that would cause ambiguity during **syntactic** analysis.

Explain why the difficulty would arise. **1**

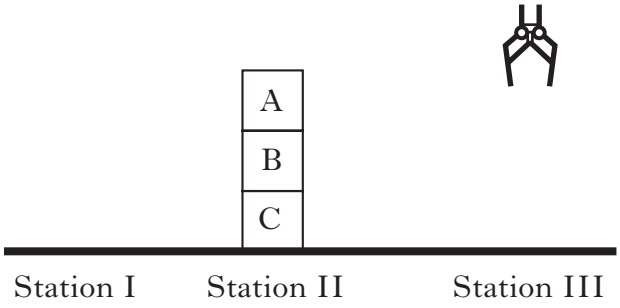
[Turn over

8. A simple *block world* consists of three blocks (A, B and C) which can be placed on a table at any of three stations (I, II and III). A block can be at one of the stations or on top of another block which is at one of the stations. They are moved by a robot arm which can grip one block at a time.

The initial state of the blocks is:



The goal state of the blocks is:



The start state can be represented by:

ontable(A,I), ontable(B,II), on(C,A), clear(B), clear(C), armempty(II).

(*a*) Draw the intermediate state represented by

ontable(A,I), ontable(C,III), on(B,A), clear(B), clear(C), armempty(I). **1**

(*b*) Represent the goal state using the notation given. **2**

(*c*) Explain why the following representation is invalid:

ontable(A,I), ontable(B,II), on(C,B), clear(A), clear(B), armempty(II). **1**

9. A robot is to be trained to pour hot, molten steel into ladles. The ladles are then moved to a different part of the factory where the steel is poured into moulds and left to solidify.

For the health and safety of the workers in the factory, it is important that the ladle is full but does not overflow. The volume of a ladle reduces each time it is used since steel not fully drained away will solidify in the ladle.

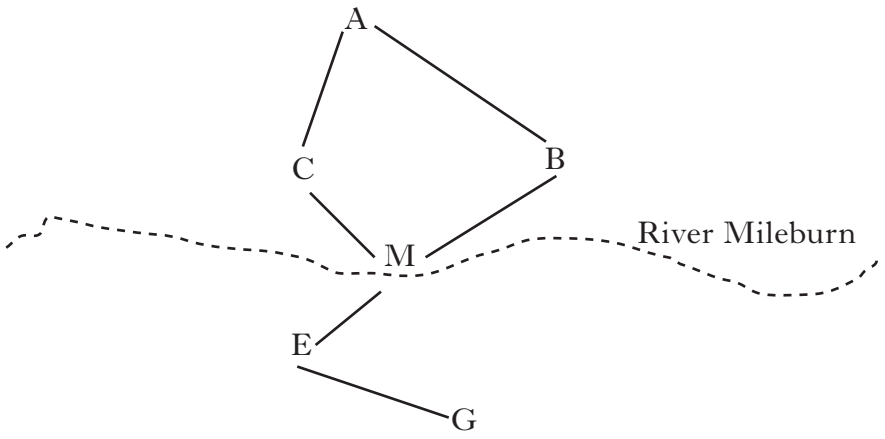
The robot has to learn how to decide that the ladle is full but not overflowing. The robot could *learn by example* or use *rote learning*.

(*a*) Explain how this robot could learn by example. **2**

(*b*) Explain why rote learning may **not** be the most appropriate learning method for this robot. **2**

[Turn over

10. Members of a country walking club are planning to walk from Amberwell (marked A in the diagram) to Gorgham (marked G in the diagram). They have to cross the River Mileburn which has only one bridge (marked M in the diagram). There is a system of public footpaths between Amberwell and Gorgham. Points B, C and E represent viewpoints along the way.



Draw the *AND/OR graph* which could be used to help to find all possible routes. **4**

11. There are three jugs which hold exactly 5, 4 and 2 litres respectively. The 4 litre and 2 litre jugs are full of water. It is assumed that water can be poured without spilling, there is no more water and there are no other jugs. When pouring from one jug to another, either the receiving jug has to be filled completely or the pouring jug has to be emptied.

(*a*) The notation

(l,m,s)

is used to denote the contents of the large 5 litre jug (l), the contents of the medium 4 litre jug (m), and the contents of the small 2 litre jug (s).

For example,

(4,0,2)

would mean that there are 4 litres in the large jug, 0 in the medium jug and 2 litres in the small jug.

The task is to divide the water into two equal amounts of 3 litres each.

Write out the notation for the *start state* and the *goal state*. **2**

(*b*) There are six *production rules* for this problem, two of which can be described as:

Fill 4 litre jug from 5 litre jug Empty contents of 2 litre jug into 4 litre jug.

(i) Describe the **four** other production rules. **2**

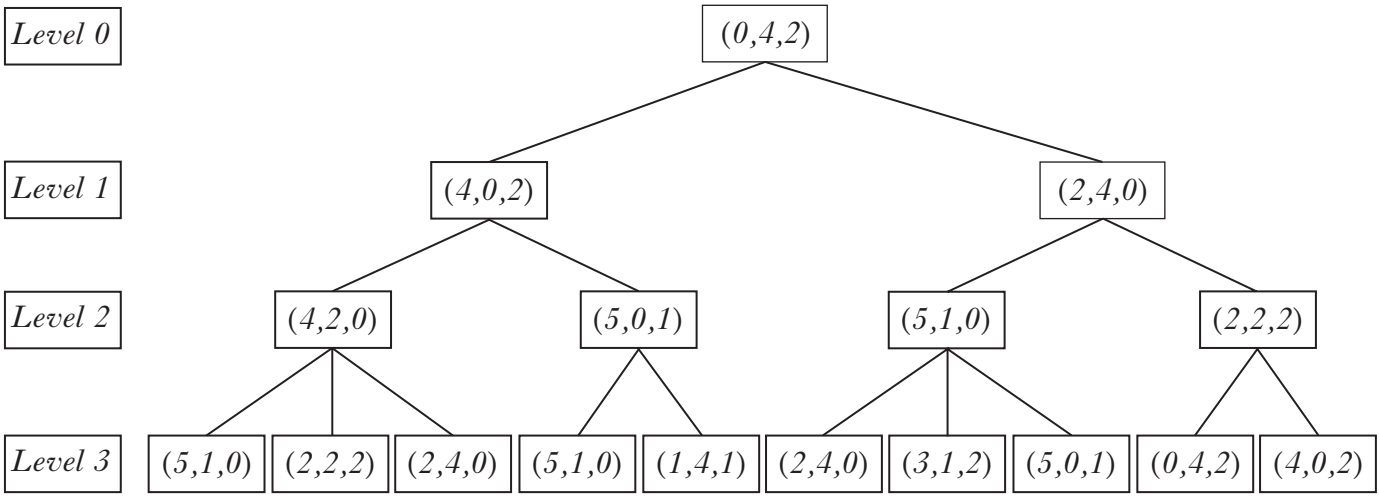
(ii) The production rule "Fill 4 litre jug from 5 litre jug" can be written as

(l,m,s) ➔ (l–(4–m),4,s)

What must be true of the values l and m before the rule can be carried out? **2**

11. (continued)

(*c*) The search tree for this problem showing nodes as far as level 3 is as follows:



(i) A goal state can be reached at level 4 from **one** of the level 3 nodes. By drawing the appropriate node from level 3 on your answer paper, extend the node to level 4 so that a goal state is reached. **1**

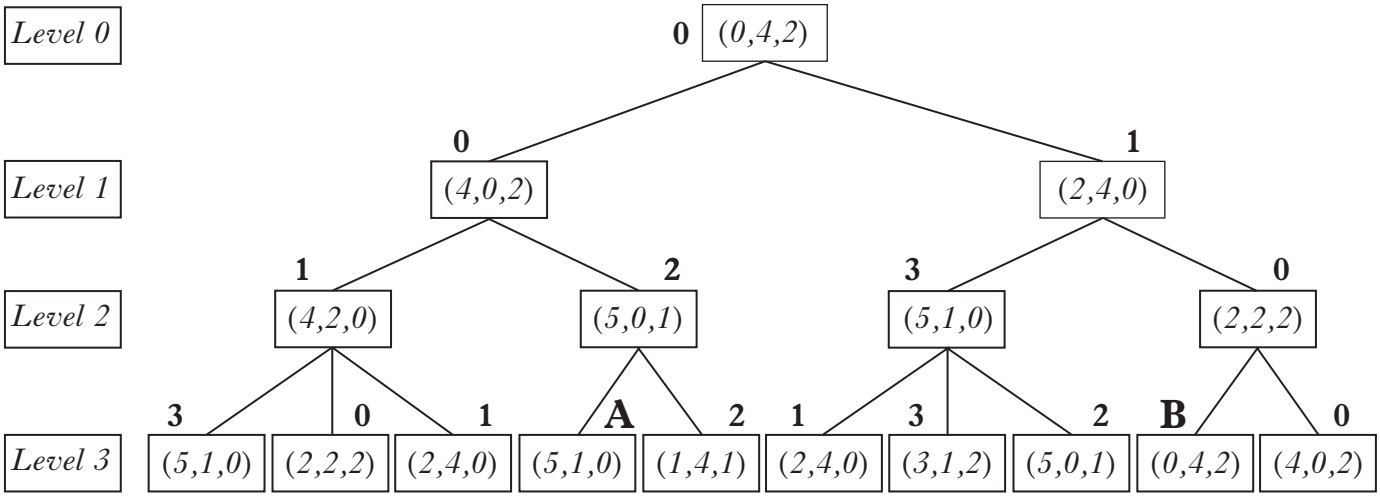
(ii) State which production rule was used for this last transition. **1**

11. (continued)

(*d*) A researcher suggests that a possible *evaluation function* for each node would be:

2 points for each jug containing exactly 3 litres
\+ 1 point for each jug containing either exactly 1 litre or exactly 5 litres
\+ 1 point if no water in smallest jug

The search tree showing the values of the evaluation function at each node is:



State the value of the evaluation function for each of the nodes:

(i) A **1**

(ii) B **1**

(*e*) *Hill-climbing* is a *heuristic search technique* which could be applied to this problem.

(i) Explain why the evaluation function defined in part (*d*) is not an effective one if the hill-climbing heuristic is to be used. **2**

(ii) Name **one** other heuristic search technique that could be tried for solving this problem. **1**

[Turn over

12. A small company specialises in printing hill-walking guides. The company is now looking to stop producing paper guides and to make all the information available online. Part of this approach will be to create a knowledge base of details of walks. The following frames have been produced as part of the knowledge acquisition process.

hill-walk	
*terrain	rugged
*average_gradient	12%

beginner	
sub_class	hill-walk
terrain	trodden path
average_gradient	4%

intermediate	
sub_class	hill-walk
average_gradient	8%

advanced	
sub_class	hill-walk

roman road	
instance	beginner

reservoir round	
instance	beginner

witches walkabout	
instance	intermediate

four peaks	
instance	advanced
average_gradient	15%

(*a*) When planning the knowledge base, the development team decided to include only the walks in the Pentland Hills.

Explain why the scope of the problem needs to be identified in the analysis stage. **1**

(*b*) Using the data in the frames to help your answer, explain the following terms:

(i) instance; **1**

(ii) sub-class; **1**

(iii) default value. **2**

(*c*) Represent the data in the frames as a semantic net. **4**

12. (continued)

(*d*) When converting the design of the knowledge base into Prolog, it is necessary to make use of rules which allow inheritance to take place.

(i) Write out **two** rules that will, for example, allow any instance of a beginner walk to inherit the properties of beginner walks. **2**

(ii) Explain why two rules are needed to fully implement inheritance in this situation. **2**

(*e*) The names of the walks are stored as a Prolog *list*. Explain how a Prolog search would evaluate whether an item is a member of a list. **3**

(*f*) As part of the online guide, it is intended to link to a rule-based system which will recommend a level of walk on the basis of medical information and fitness.

Two rules in the system are:

IF body_mass_index=normal AND blood_pressure=high AND lung_function=average AND step_test=poor THEN recommended_walk_type=beginner	IF body_mass_index=underweight AND blood_pressure=high AND lung_function=poor AND step_test=poor AND muscle_flex_test=weak THEN recommended_walk__type=none

(i) Explain what is meant by the *conflict set* that could arise when the system is used. **1**

(ii) Describe **two** conflict resolution strategies that could be used when a conflict set arises. **2**

(60)

[*END OF SECTION II—PART A*]

[Turn over for Section II Part B

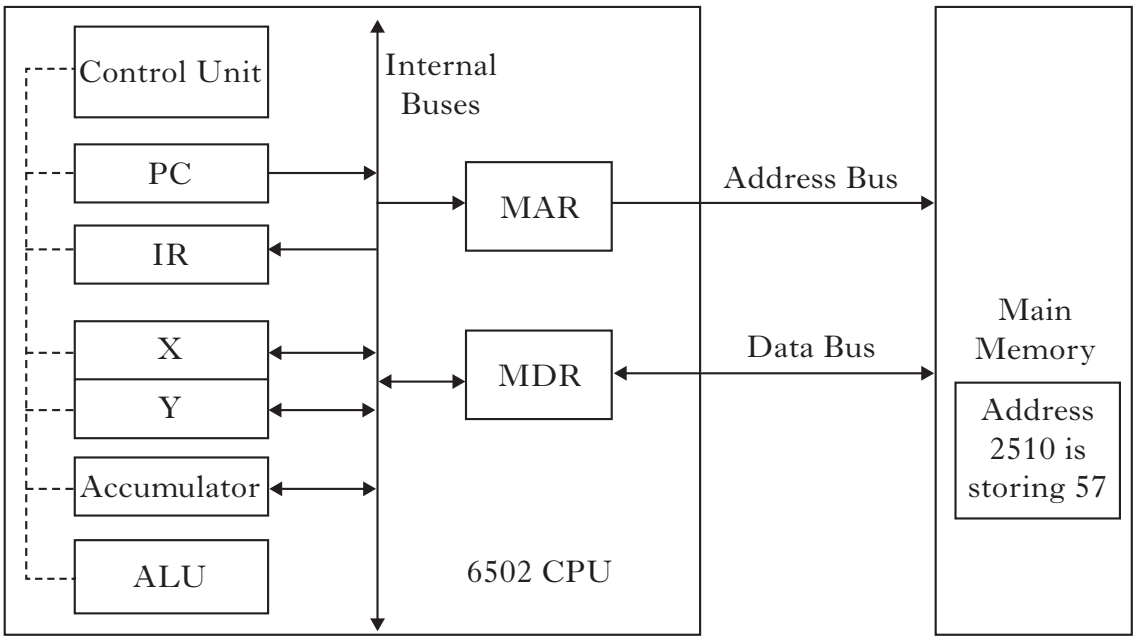
SECTION II

Marks

Part B — Computer Architecture

Answer ALL questions in this section.

13. The 6502 processor has an 8 bit data bus and a 16 bit address bus. The simplified diagram below shows some of the *registers* in the processor.



The accumulator, X and Y registers are *general purpose registers*.

An assembly language program written for this processor includes an instruction "ASL" which means "*Shift the bits in the accumulator left by one bit*". This instruction is a single byte op-code which does not have an operand. The numeric representation of this op-code is 57.

When the program has been translated into machine code and loaded into memory, the ASL instruction is stored in one byte of memory at address 2510. Immediately before this instruction is executed, the value in the accumulator is 1.

(*a*) Detail the steps that occur in the *fetch – execute cycle* as the ASL instruction is processed. You should name the registers that are involved and the values that are stored in them at each stage of the cycle. **6**

13. (continued)

(*b*) "ASL" is an example of a shift instruction for the 6502 processor. For an assembly language of your choice, give an example **and** description of an instruction for:

(i) An **unconditional** branch; **2**

(ii) Transferring a value from one register to another register. **2**

(*c*) The following source code is a section of an *assembly language* program:

Line	Label	Instruction	Comment
1		LDA #0	Load the accumulator with value zero
2		LDX #0	Load the X register with value zero
3	continue	INX	Increase the value of the X register by 1
4		STX counter	Copy the X register value into memory address "counter"
5		ADC counter	Add the value stored at memory address "counter" to the accumulator
6		CPX #4	Compare the value stored in the X register with value 4
7		BNE continue	If the values being compared were not equal, branch to the instruction labelled "continue"
8		STA result	Copy the accumulator value to memory location "result"

(i) By doing a dry run of this section of code, describe what it does. **2**

(ii) If the line of code

7		BNE continue	If the values being compared were not equal, branch to the instruction labelled "continue"

is replaced with the line

7		BEQ continue	If the values being compared were equal, branch to the instruction labelled "continue"

explain what the code would do now. **2**

Part B — Computer Architecture (continued)

14. (*a*) The specification sheet of a processor shows that it has a 16Kb *Level 1 cache* and a 256Kb *Level 2 cache*.

(i) The processor is currently fetching an instruction from memory.

With reference to the use of level 1 and level 2 cache memory, describe the possible events that may occur when the processor attempts to fetch the instruction. **4**

(ii) Explain why cache memory is so effective in speeding up the execution of programs that contain loops. **2**

(*b*) A processor has a set of *Single Instruction Multiple Data* (*SIMD*) *instructions* that can operate on eight special 128 bit SIMD registers.

(i) Describe what is meant by a SIMD instruction. **1**

(ii) Describe a possible processing operation on a grid of display pixels that could make use of SIMD instructions. **1**

(iii) The program currently running is displaying pixels in 32 bit colour. Calculate the theoretical improvement in performance that the use of SIMD instructions would bring to the operation described in (ii) when compared to a processor which applied the operation to one pixel at a time. Show the details of your working for this calculation. **2**

15. *Direct Memory Access* (*DMA*) will improve system performance when transferring a large amount of data from a hard drive to main memory.

(*a*) **With the aid of one or more diagrams**, describe how DMA works. **3**

(*b*) Explain how DMA improves system performance **2**

Part B — Computer Architecture (continued)

16. (*a*) Modern processors incorporate features that have been inherited from earlier processors based on *RISC* and *CISC* architecture.

(i) Describe **one** feature of RISC technology that is likely to be incorporated into a modern processor and explain the benefits. **2**

(ii) Describe **one** feature of CISC technology that is likely to be incorporated into a modern processor and explain the benefits. **2**

(*b*) A processor has been designed to incorporate several *pipelines*. *Predication* is a technique that can improve the efficiency of execution of programs that include branches.

(i) Describe how predication works. **3**

(ii) Explain how predication can improve the efficiency of execution. **1**

(*c*) A *superscalar* processor has several independent pipelines and allows the processing of instructions in parallel.

Name and describe a **software technique** that can improve the efficiency of execution of a program using multiple pipelines in a superscalar processor. **2**

[Turn over

17. A computer system runs a multi-user *operating system*.

(*a*) When the computer is booting up, the operating system will create and start a number of *services*.

(i) Explain what is meant by a "service". **1**

(ii) Describe one service that enables communications between programs. **1**

(iii) Describe a benefit of the operating system providing a service rather than individual applications providing the same functionality. **1**

(*b*) Modern operating systems provide libraries of routines (sometimes known as the API) which are available for applications to call as required.

(i) Describe a problem relating to library routines that could occur when installing new software on a computer system. **1**

(ii) Explain why software developers may choose to write their own routines rather than using the library routines provided by the operating system. **2**

(*c*) The operating system provides security for files by using *file attributes*.

(i) State an example of a file attribute that can be used to provide file security and describe how it can be used. **2**

(ii) Explain how file attributes can be used to control user access to files in *multi-user systems*. **2**

(iii) A user attempts to delete a file that he created in his home folder. He gets a message

"Error! – File cannot be deleted". Suggest a likely reason for this error message. **1**

(*d*) The operating system provides a graphical user interface so that a user can point and click on a file icon and then press the "Delete" key to delete the file.

During the deletion process, there will be demands made on the system resources by various functions of the operating system.

Describe how the main functions of an operating system will be involved during the various stages of the deletion process. **4**

Part B — Computer Architecture (continued)

18. A computer system is using a *multitasking operating system*.

(*a*) One of the functions of an operating system is *memory management*.

(i) Name and describe **one** method of allocating memory to a process. **2**

(ii) Describe **one** problem that may occur after a number of processes have been created and terminated. **1**

(*b*) The operating system manages the efficient running of processes by using a *round robin scheduling system*.

(i) One of the processes requires a total of 35 milliseconds of processing time to fully execute, but the scheduling system only allows each process to have 10 milliseconds of processing time before pre-empting it and moving on to the next process. This process will need at least four "slices" of processing time before it completes.

The operating system must therefore manage the order in which processes in the round robin are presented to the processor so that all processes have a fair share of processing time.

Explain why a **queue** is used for the implementation of a round robin scheduling system. **1**

(ii) Processes in a round robin scheduling system may be in three possible states. Apart from running out of time, describe two other circumstances causing the state of a process to change while it is in the round robin queue. **2**

(60)

[*END OF SECTION II—PART B*]

[Turn over for Section II Part C

SECTION II

Marks

Part C — Computer Networking

Answer ALL questions in this part.

19. A large multinational company currently uses the SMTP protocol to send e-mail messages between e-mail servers.

(*a*) Every e-mail that is sent includes a header and a message body.

One of the items in the header is the subject, which contains a summary of the topic of the message. Describe **two** other items that might appear in the header. **2**

(*b*) POP is a protocol that is used in conjunction with SMTP in the transmission of e-mail messages. Explain why the POP protocol is also required. **1**

(*c*) A software developer has been hired to produce enhanced, replacement e-mail software.

(i) Explain **one** benefit of developing software that does **not** follow existing standards. **1**

(ii) State **one** benefit to the software developer of following an existing standard when developing software. **1**

(iii) State **one** benefit to the user if the new e-mail client works with existing standards. **1**

(*d*) The operation of the e-mail software can be described using either the *OSI model* or the *TCP/IP model*.

(i) Name the layer of the TCP/IP model at which the new e-mail protocol will operate. **1**

(ii) Name the **three** layers of the OSI model at which the new e-mail protocol will operate. **2**

(*e*) The developer has decided that the MIME standard would be suitable for use in the replacement e-mail software.

Describe the role of MIME in the sending and receiving of e-mail attachments. **3**

Part C — Computer Networking (continued)

20. The Hootenanny High School campus consists of four buildings, each of which has 100 computer workstations connected to the school intranet.

The network administrator has been allocated the CIDR network address of 155.20.42.0/23 by the school's Internet Service Provider.

(*a*) Explain the benefit of allocating IP addresses using CIDR rather than the class-based system. **3**

(*b*) The network administrator wants each of the school buildings to have its own *subnet*. Subnetting is implemented using *subnet masks*.

(i) Explain, giving **two** reasons, why subnetting would benefit the school in this situation. **4**

(ii) Calculate the value of the subnet mask that would be used to split the school's IP address allocation into four equally sized subnets. **2**

(iii) If the network address of the first building's subnet is 155.20.42.0, calculate **two** of the network addresses of the other three subnets. **2**

21. Charlie works for Web4U, http://www.web4u.co.uk/, a website development studio that produces websites for their customers.

(*a*) Charlie is assigned the task of adding a hyperlink on each page of Web4U's customers' web pages, advertising the company's web design services.

Web page professionally designed by Web4U.

Write the HTML code which Charlie could add that would display the above message in the middle of a line, hyperlinked to Web4U's own website. **3**

(*b*) A Web4U customer cannot access their own website. Charlie is asked to diagnose and fix the problem.

(i) Charlie can either use *Ping* or *Traceroute* to diagnose the problem. State what extra information is provided by Traceroute. **1**

(ii) State **two** possible network problems that Traceroute can help to diagnose. **2**

(*c*) (i) Name and describe the operation of a *denial of service attack* which exploits a vulnerability in the Ping command. **3**

(ii) For the denial of service attack which exploits Ping vulnerabilities, state two firewall rules that could be implemented that would help prevent this type of attack. **2**

22. A group of financial advisors work for banks in many countries around the world. They have to be in constant communication with their customers, and rely heavily on the use of video conferencing.

(*a*) (i) During a video conference call, describe **two** processes that must be applied to the video data after being captured by the webcam and before being viewed by the recipient. **2**

(ii) Describe **one** impact of increasing the sample rate of video on the resources required to stream it across the network. **2**

(*b*) The financial advisors exchange confidential data with their customers, and therefore must take precautions to ensure their data transmissions are secure and authenticated.

(i) Describe how *public-key encryption* could be used for the secure exchange of files. **3**

(ii) Explain why *public-key encryption* is more suitable in this situation than *conventional encryption* for securely transferring files. **1**

23. Auld Time Books has bookshops across Scotland. The head office has a centralised database, which is accessed by all branches to order more books and record sales.

(*a*) Auld Time Books opens seven days a week from 9am to 5pm.

Suggest and justify a weekly backup schedule, making full use of *full*, *differential*, and *incremental* backups. **3**

(*b*) Individual bookshops use *tunnelling* to connect to the head office computers.

(i) Describe how tunnelling allows a secure connection to be made to the head office. **2**

(ii) One tunnelling protocol that could be used is *PPTP*. Name an alternative protocol. **1**

(iii) Describe **two** advantages of this alternative protocol over PPTP. **2**

Part C — Computer Networking (continued)

24. Aufaewee Town Council is upgrading its intranet, which connects all the council buildings spread across the town.

(*a*) State **two** technical characteristics of fibre optics and explain why it is the most appropriate cabled network technology to connect the council buildings. **4**

(*b*) In order to allow council workers to make efficient use of portable tablet computers, it is decided to install a wireless network in each building.

(i) State a suitable wireless network standard. **1**

(ii) State **three** network security precautions that the engineers could implement when installing the wireless network. **3**

(*c*) Describe how Aufaewee Town Council could *beta test* the network **before** completing the upgrade project. **2**

(60)

[*END OF SECTION II—PART C*]

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