X206/301

NATIONAL QUALIFICATIONS 2009

THURSDAY, 4 JUNE 9.00 AM – 11.30 AM

COMPUTING HIGHER

Attempt **all** questions in Section I.

Attempt **all** questions in Section II.

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

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

Read all questions carefully.

Do not write on the question paper.

Write as neatly as possible.

SECTION I

Marks

Attempt all questions in this section.

1. (*a*) Write the binary number 1000100111 as a **positive** integer. **1**

(*b*) Represent the decimal number –73 using 8 bit *two's complement*. **1**

2. Most modern computers use *Unicode* rather than *ASCII* to represent text.

State one **advantage** of Unicode when compared to ASCII. **1**

3. State the number of bits required to represent 16 777 216 colours. **1**

4. System software consists of the operating system and utility programs.

(*a*) A *disk editor* is a common example of utility software. Describe **one** function of a disk editor. **1**

(*b*) The *bootstrap loader* is part of the operating system. State the purpose of the bootstrap loader. **1**

5. A *trojan horse* is a malicious computer program. State **one** characteristic of a trojan horse. **1**

6. Explain why increasing the number of *registers* could improve system performance. **1**

7. A piece of software has been installed on a computer. A compatibility issue may prevent the new software from running properly on the computer.

(*a*) State **one** possible **software** compatibility issue that might prevent the new software from running. **1**

(*b*) State **one** possible **hardware** compatibility issue that might prevent the new software from running. **1**

8. A company is advised to change from a *peer-to-peer* network to a *client-server* network.

(*a*) Describe **one** difference between a peer-to-peer network and a client-server network. **2**

(*b*) Describe **one** possible technical reason for choosing a client-server network over a peer-to-peer network. **1**

SECTION I (continued)

9. A graphic file is to be transferred as an e-mail attachment. Explain why a *JPEG* file might be preferred to a *TIFF* file for the graphic in this situation. **2**

10. The software development process is described as an *iterative* process.

Explain how the iterative nature of the software development process is used in the production of software. **2**

11. The *software specification* can act as part of the legal contract between the client and the software development company.

State **two** other purposes of this document. **2**

12. A program is being designed which generates a username using the following steps:

1. get user initial and surname
2. create username
3. display the username

(*a*) Show how these steps could be represented using a *graphical design notation*. **2**

(*b*) The username is created by joining the initial to the end of the surname, for example "CarrickE".

Name the *string operation* used to create the username. **1**

13. Many applications contain scripting languages.

Explain why there is a need for scripting languages within applications. **1**

14. Name **one** type of personnel involved in the *documentation* stage. **1**

15. Software can be evaluated in terms of *robustness* and *reliability*.

(*a*) Explain what is meant by the term "robustness". **1**

(*b*) Explain what is meant by the term "reliability". **1**

[Turn over

SECTION I (continued)

16. Software may require adaptive maintenance when a new operating system is installed.

Describe **one** further example of when adaptive maintenance would be required. **1**

17. A program is created during the implementation stage of the software development process.

(*a*) Programmers may make use of a *module library*. State what is meant by the term "module library". **1**

(*b*) The program may require a *user-defined function*. State what is meant by the term "user-defined function". **2**

(30)

[*END OF SECTION I*]

Marks

SECTION II

Attempt all questions in this section.

18. A palmtop computer has a processor with a 24 bit address bus, 32 bit data bus and 8 control lines. The palmtop computer accepts *flash cards* as additional storage.

(*a*) The processor receives a signal on an *interrupt* control line. Explain what happens when the processor receives the signal. **2**

(*b*) Calculate the **maximum** amount of memory that the palmtop computer can address.

Express your answer in appropriate units. Show all working. **3**

(*c*) Data is to be transferred from the processor to main memory using a *write* operation.

Describe how a processor would perform a **write** operation. Your answer should mention the *buses* or *control lines* used at **each** stage. **4**

(*d*) A file created on the palmtop is to be stored on the flash card. The *file management* and *input/output management* functions of the palmtop's operating system are used during the transfer.

Describe **one** task carried out by **each** of these functions. **2**

(*e*) The price of *flash cards* has decreased in recent years as their capacity has increased.

State **one** other recent trend in the development of flash cards. **1**

19. Pat has a *wireless enabled* laptop in his house. He uses this to **illegally** access his neighbour's wireless network.

(*a*) Name the Act of Parliament that makes this network access illegal. **1**

(*b*) Pat's computer has anti-virus software installed. One technique used by anti-virus software to **detect** a virus is *virus signature recognition*.

(i) Name **one** other virus **detection** technique. **1**

(ii) Describe how the technique you named in part (i) detects a virus. **1**

(iii) Describe how a virus might use *camouflage* to **avoid** virus signature recognition. **1**

[Turn over

SECTION II (continued)

20. A network is configured as a *star* topology. It contains **four** computers and a *switch*.

(*a*) Draw a **labelled** diagram of this star topology. You should **clearly** show the location of the **switch**. **2**

(*b*) Describe **one** advantage of using a *star* topology compared to a *bus* topology. **1**

(*c*) Explain why using a *switch* rather than a *hub* may improve the performance of a network. **2**

(*d*) Explain why the addition of a print server to a large network contributes to an improvement in network performance. **1**

(*e*) Developments in *browser software* have contributed to the increase in the use of networks.

Describe **two** of these developments. **2**

21. One function of an *interface* is to store data in transit between the computer and a peripheral.

(*a*) State **one** other function of an interface. **1**

(*b*) (i) Describe how data is transferred using a *serial interface*. You may include a diagram in your answer. **2**

(ii) Describe how data is transferred using a *parallel interface*. You may include a diagram in your answer. **2**

(*c*) State **one** advantage of a serial interface over a parallel interface. **1**

SECTION II (continued)

22. NoTow is a company running a city centre car park. The company requires software to control the operation of the car park. The software will have modules for actions such as "recognising a car is at a barrier", "printing an entry ticket" and "calculating ticket charge".

(*a*) Name the most suitable **type** of programming language to implement this software. Explain your answer. **2**

(*b*) The software is written using modules. Describe **two** benefits to the programmer of writing modular code. **2**

(*c*) After the software is written, testing is carried out.

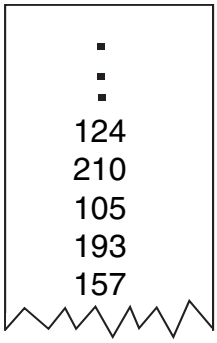
(i) "Testing should be planned in advance with the creation of a test plan containing the test data to be used and the expected results."

State the **aspect** of testing being described here. **1**

(ii) "Testing should be as thorough and complete as possible covering every part of the program with all kinds of test data and testers."

State the **aspect** of testing being described here. **1**

NoTow would like the software to calculate the number of cars on a particular day that spent more than three hours in the car park. The number of whole minutes each car is parked in the car park is stored in a list, as shown on the right.



(*d*) Use *pseudocode* to design an algorithm to carry out this calculation. **4**

(*e*) The output from part (*d*) is turned into a percentage of the total number of cars using the car park in a day. This is stored in a variable called **percent**.

Using a programming language with which you are familiar, show how to format the output to **two** decimal places. **2**

(*f*) Identify the **type** of *maintenance* used to add the module described in part (*d*). Justify your answer. **2**

[Turn over

SECTION II (continued)

23. A cinema ticket system allows customers to select and pay for their own tickets.

The top level algorithm is:

1. Get ticket details
2. Calculate cost
3. Display cost and accept payment

The module **CalculateCost** uses the number of tickets and the category of ticket to calculate the total payment due. It uses the *parameters* described below.

Parameter	Description
Amount	Number of tickets
Category	Adult, child, student, OAP
Cost	Total cost of required tickets

(*a*) State the most suitable *data type* for the parameter called **Cost**. **1**

(*b*) Parameters can either be passed by *value* or by *reference*.

(i) Identify **one** parameter that is passed **by value** to the module **CalculateCost**. Justify your answer. **2**

(ii) Identify **one** parameter that is passed **by reference** to the module **CalculateCost**. Justify your answer. **2**

(*c*) A program may use *local* variables and *global* variables.

(i) What is the *scope* of a **global** variable? **1**

(ii) State **two** advantages of using *parameter passing* rather than *global* variables when programming. **2**

(*d*) State **one** reason why *portability* of software is an important factor for developers to consider. **1**

SECTION II (continued)

23. (continued)

(*e*) To calculate the total cost, the program must check the category of each ticket against the four possible categories. The programmer could use **a series of IF statements** or a **nested IF** as shown below.

Series of IF statements:

```
IF category = 'adult' THEN Price=5.50
IF category = 'child' THEN Price=3.50
IF category = 'student' THEN Price=4.50
IF category = 'OAP' THEN Price=4.00
```

Nested IF:

```
If category = 'adult' THEN
    Price=5.50
ELSE IF category = 'child' THEN
    Price=3.50
ELSE IF category = 'student' THEN
    Price=4.50
ELSE IF category = 'OAP' THEN
    Price=4.00
END IF
```

(i) The programmer decides to use a nested IF. Explain why this is a more **efficient** method. **2**

(ii) State **one** other *multiple outcome selection* statement that the programmer could have used. **1**

(*f*) The program will make use of a *1-D array*.

(i) When creating, or declaring, a 1-D array for use in a program, a name must be given to the array.

State **two** other items that should be specified when the array is created. **2**

(ii) Explain why it is a more *efficient* use of system resources to pass an array **by reference** rather than **by value**. **2**

(60)

[*END OF SECTION II*]

[Turn over

SECTION III

Attempt ONE sub-section of Section III

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

SECTION III

Marks

Part A—Artificial Intelligence

Attempt all questions.

24. A human tester communicates with one human and one computer using remote terminals. The tester is to identify which terminal is connected to the human and which is connected to the computer.

(*a*) State the name of this test. **1**

(*b*) State **one** limitation of this test. **1**

(*c*) (i) State **one** strategy that the human tester could use to differentiate between the human and the computer. **1**

(ii) Explain why the strategy suggested in (*c*)(i) helps the tester to tell the difference between the human and the computer. **1**

25. *Natural Language Processing* (NLP) involves creating software that uses language in a similar way to people.

(*a*) State **two** common applications of NLP. **2**

(*b*) NLP has to deal with *ambiguity of meaning* in sentences.

(i) Describe what is meant by "ambiguity of meaning" in a sentence. **1**

(ii) The speech recognition stage of NLP correctly recognised the following sentences.

Sentence 1 "The man threw a bottle at the window and broke it."

Sentence 2 "The restaurant was full of international food specialists."

State **one** example of ambiguity from **each** sentence. **2**

(*c*) Name the stage of NLP that would attempt to resolve ambiguity in a sentence. **1**

(*d*) (i) Name the stage that takes place after your answer to (*c*). **1**

(ii) Explain why it is important to deal with ambiguity prior to this stage. **1**

(*e*) Regional accents or pronunciations, as well as ambiguity, can cause problems for NLP.

State **two** other problems for NLP, using an example to illustrate each answer. **4**

[Turn over

SECTION III

Part A—Artificial Intelligence (continued)

26. A bicycle manufacturer is developing an *expert system* to advise customers on their bicycle purchase.

(*a*) State **one** reason why the bicycle manufacturer's *domain* is suitable. **1**

(*b*) The following paragraph contains some of the information for the proposed expert system.

> Racing and mountain are two types of bicycle. Racing bicycles have drop handle bars. Hardtails and full-suspension are two types of mountain bicycle.

Draw a *semantic net* to represent this information. **4**

(*c*) An expert system can be created using an *expert system shell*.

(i) Name and describe **one** component of an expert system shell. **2**

(ii) State the component that must be added to an expert system shell to create an expert system. **1**

(*d*) Other than faster development time, state **one** advantage of creating an expert system using an expert system shell rather than a declarative language. **1**

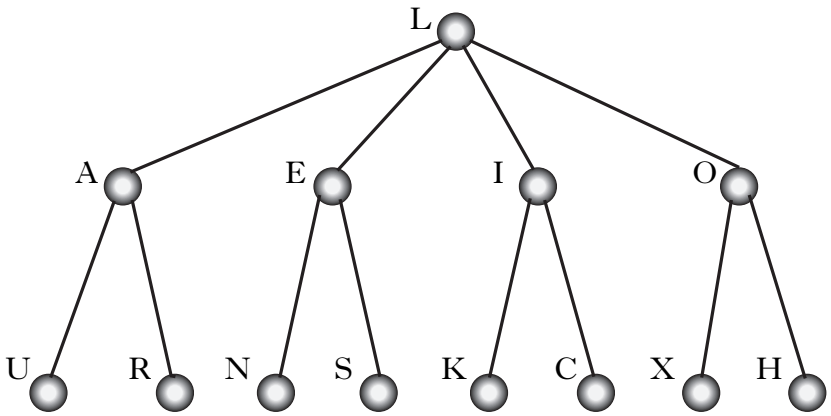
SECTION III

Part A—Artificial Intelligence (continued)

27. A *search tree* is shown below.

Node **L** is the **start**, or initial, state.

Node **N** is the **goal** state.



(*a*) State the order in which nodes would be visited using a *breadth-first* search, stopping when the goal state is reached. **1**

(*b*) (i) State the order in which nodes would be visited using a *depth-first* search, stopping when the goal state is reached. **1**

(ii) List the nodes stored in *working memory* when the goal state is found using a **depth-first** search. **1**

(iii) Explain your answer to (*b*)(ii) making reference to the search tree. **2**

(*c*) Search trees can result in *combinatorial explosion*.

(i) Describe what is meant by a "combinatorial explosion". **2**

(ii) The game of chess is one example of a problem that results in combinatorial explosion. State another example. **1**

(iii) Describe how a heuristic search can be used to overcome the problems of combinatorial explosion. **2**

(iv) Explain **one** way in which faster processors can improve the speed of a heuristic search. **1**

(*d*) Explain why the use of *cache memory* could improve search times. **2**

[Turn over

SECTION III

Part A—Artificial Intelligence (continued)

28. The following knowledge base contains information about various animals.

```
1 subclass(monotreme, mammal).          A monotreme is a subclass of mammal.
2 subclass(platypus, monotreme).
3 subclass(anteater, mammal).

4 has(bird, egg_laying).                Birds lay eggs.
5 has(mammal, live_young).              Mammals have live young.
6 has(mammal, warm_blood).

7 has(platypus, egg_laying).

8 has(X,Y)IFsubclass(X,Z)AND has(Z,Y).  X has the property Y if X is a subclass of Z AND
                                        Z has the property Y.
```

(*a*) (i) State the answers to the query:

```
?-has(X, egg_laying).
```

2

(ii) State the query for the question "What are the subclasses of mammal?". **1**

(*b*) Assuming that a depth-first search is used, trace the first **two** solutions to the query:

```
?-has(platypus, Y).
```

You must include the correct use of the term *sub-goal* in your trace.

Use the line numbers to help your explanation. **7**

(*c*) Explain the difficulty with the answers to part (*b*). **1**

(*d*) State the name of the type of rule used in line 8. **1**

(50)

[*END OF SECTION III—PART A*]

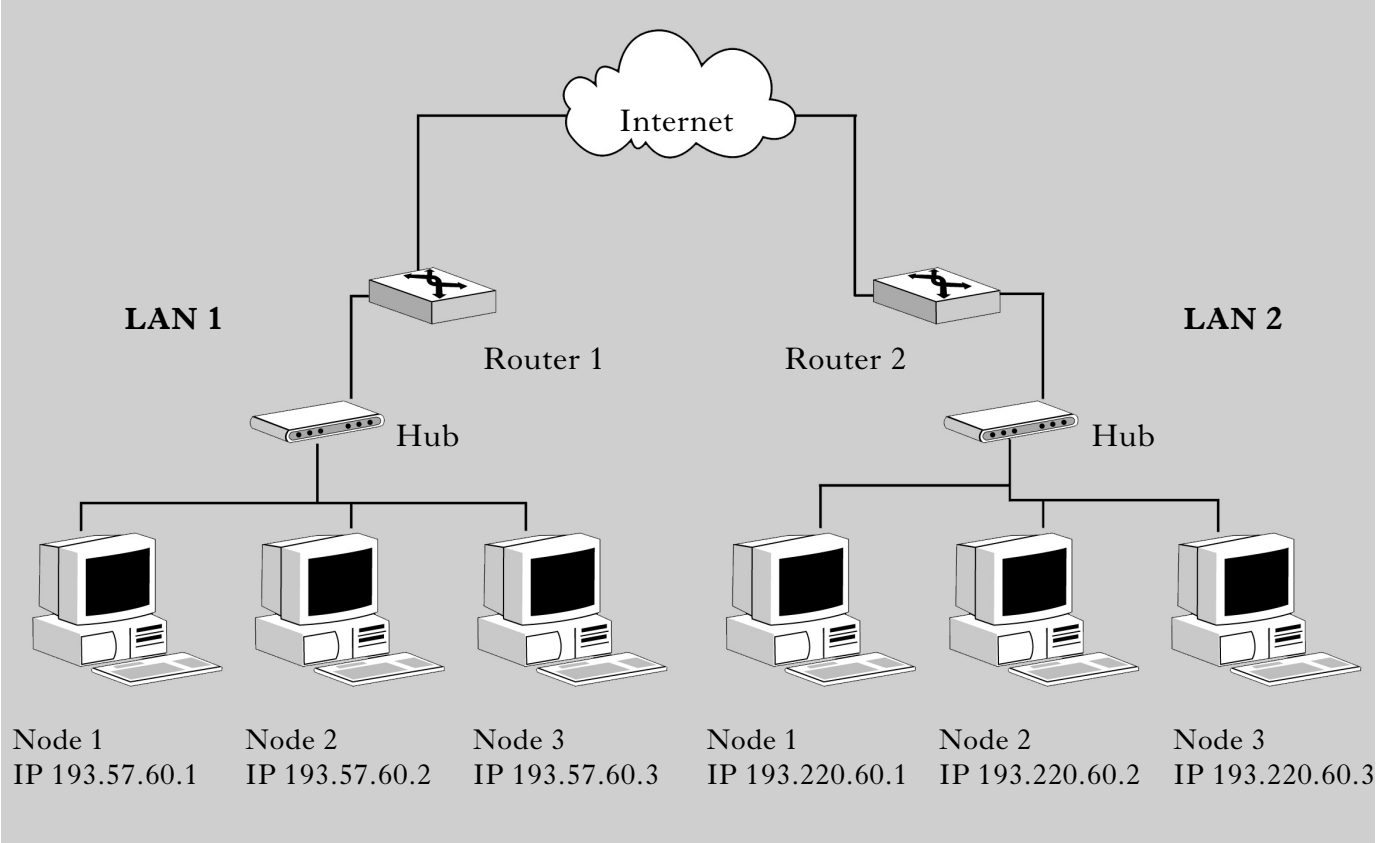
SECTION III

Part B—Computer Networking

Marks

Attempt all questions.

29. The diagram below shows the configuration of two *intranets*. Each LAN is connected to the Internet via a *router*.



(*a*) (i) State the *class* of network for LAN 1. Justify your answer. **2**

(ii) State how many **additional** nodes can be connected to LAN 1. Justify your answer. **2**

(*b*) Node 1 on each of the LANs has the same hardware specification and operating system.

(i) State a possible reason why node 1 on LAN 2 may have a better performance. **1**

(ii) Justify your answer to part (i). **1**

(*c*) State why it is possible for the three stations on LAN 1 to communicate if they have different operating systems. **1**

A mail message is sent from node 1 on LAN 1 to node 3 on LAN 2 using *TCP/IP*.

(*d*) State a suitable *application layer* protocol when sending the message. **1**

(*e*) Describe in detail the role of TCP when sending and receiving the message. **3**

(*f*) A *Cyclic Redundancy Check* (CRC) is used to check the data packets for errors. Describe the operation of CRC. **3**

(*g*) Describe how a router ensures that the data packets reach the **correct** destination. **2**

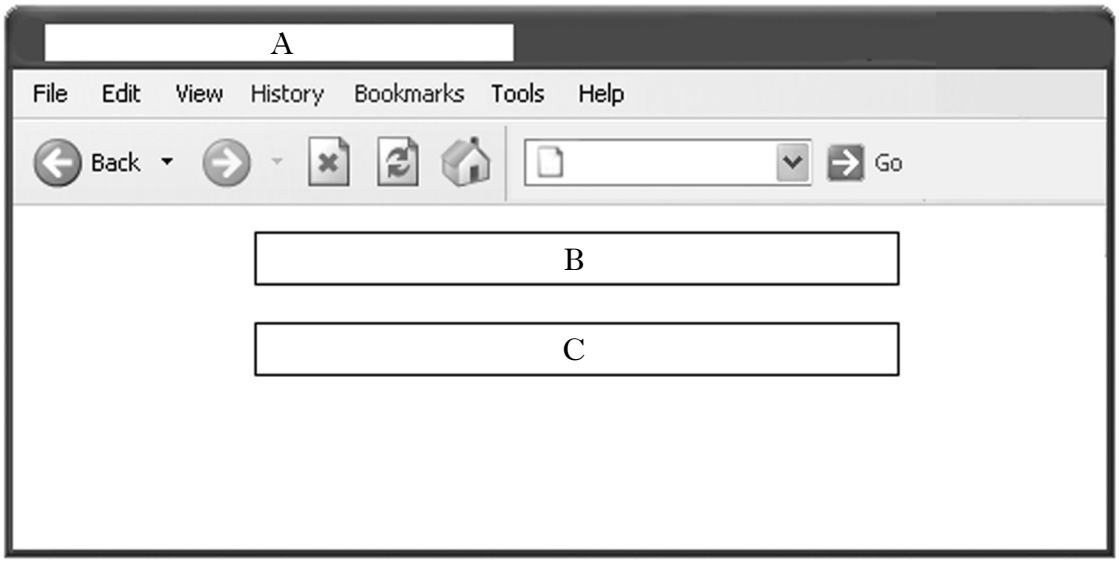
SECTION III

Part B—Computer Networking (continued)

30. Hamish is creating a website for the Highland Chess League. Part of the *HTML* for the home page is shown below.

```
<head>
        <title>Highland Chess League</title>
        <meta name="description" content="The Highland Chess League"/>
        <meta name="keywords" content="chess,league,games,Highland,hobbies"/>
</head>
<body>
        <div align="centre">
        <p>Welcome to the Highland Chess League Home Page</p>
        <p>Play the board <u>not</u> the man</p>
        </div>
</body>
```

(*a*) The window below is seen when a browser is used to view the home page. Use the HTML code above to identify the contents displayed in A, B and C. **3**



(*b*) Hamish uses *FTP* once he has developed the website. State what FTP is used for in this situation. **1**

(*c*) (i) State the purpose of the following line of the HTML code. **2**

```
<meta name="keywords" content="chess,league,games,Highland,hobbies"/>
```

(ii) Describe how a *spider* would use this line of code. **2**

(iii) Explain why one search engine may provide more relevant and comprehensive results than another. **2**

SECTION III

Part B—Computer Networking (continued)

30. (continued)

(*d*) Morag knows that Hamish is working on the website. She enters http://www.highlandchess.com into her browser and receives the following message.

> **The requested URL could not be retrieved**
>
> While trying to retrieve the URL:http://www.highlandchess.com
>
> The following error was encountered:
>
> DNS Server unable to resolve

(i) Describe the events that led to this message being displayed. **3**

(ii) State what Hamish must do to make the website accessible to the public. **1**

31. The owner of a local coffee shop has decided to provide Internet access for his customers. A computing company sends one of their personnel to examine the coffee shop and interview both the owner and the staff.

(*a*) State the **job title** of the person sent from the computing company. **1**

(*b*) The coffee shop can either be wired with network access points in the wall or a wireless access point can be installed.

(i) State **two** reasons why the wireless access point solution was chosen. **2**

(ii) State a suitable type of Internet connection for the coffee shop. **1**

(*c*) The wireless network is correctly installed, but customers complain that at certain times the Internet access is very slow. State **one** reason for this drop in performance. **1**

[Turn over

SECTION III

Part B—Computer Networking (continued)

32. A college intranet is used by lecturers, technicians and students. The technicians need to be able to install software and configure computers on the network.

(*a*) Explain how it is possible to allow **only** the technicians to install software. **1**

(*b*) A hacker intercepts student records which are being sent between two lecturers.

(i) State the term used to describe this type of attack. **1**

(ii) Describe **one** software technique to defend against this type of attack. **1**

(*c*) Explain the difference between a *backup strategy* and *disaster avoidance techniques*. **2**

(*d*) A **differential** backup contains all files that have changed **since** the last **full** backup.

(i) State **one** advantage of using this type of backup compared to a full backup of data. **1**

(ii) Describe a situation where a differential backup would not provide any advantage over a full backup. **1**

(*e*) The intranet is connected to the Internet. This may cause both **access** and **security** issues.

(i) Describe the technique known as *Internet filtering*. **1**

(ii) Describe the technique known as a *walled garden*. **1**

(*f*) State **two** reasons why Internet filtering would be more appropriate for the college. **2**

(*g*) *Application filtering* is a technique used by a firewall. Name and describe **one** other technique. **2**

(*h*) Describe the meaning of the terms:

(i) data integrity; **1**

(ii) data security. **1**

(50)

[*END OF SECTION III—PART B*]

Marks

SECTION III

Part C—Multimedia Technology

Attempt all questions.

33. The company VideoStream specialises in video recording devices.

(*a*) Ten years ago, VideoStream's best selling product was their VS32 video capture card. Due to advances in video camera technology, the VS32 video capture card is no longer for sale.

(i) One of the main components of the video capture card is the DSP. Describe the role of the DSP. **1**

(ii) Describe the technological advance in video cameras that has resulted in the drop in sales of **all** video capture cards. **1**

(*b*) Derek has bought VideoStream's latest video camera that comes with free video editing software.

(i) Derek records a two minute video using 24-bit colour and a 1000 by 800 pixel frame size at 10 frames per second. Calculate the file size of the uncompressed video. Show all working and express your answer in appropriate units. **3**

(ii) The settings in part (i) produced a poor quality video. Explain why the video is poor quality. **1**

Derek records several video clips and tries out the free video editing software. He loads the video clips and then uses two features of the video editing software to edit the video as shown below.

(iii) Name **two** features of the video editing software that Derek has used to edit the video. **2**

(*c*) The default format for saving video clips from all VideoStream's products is AVI. AVI is an example of a *container file*.

Explain why AVI is a "container file". **1**

(*d*) MPEG is a compressed video file type. Describe how MPEG achieves compression. **3**

[Turn over

SECTION III

Part C—Multimedia Technology (continued)

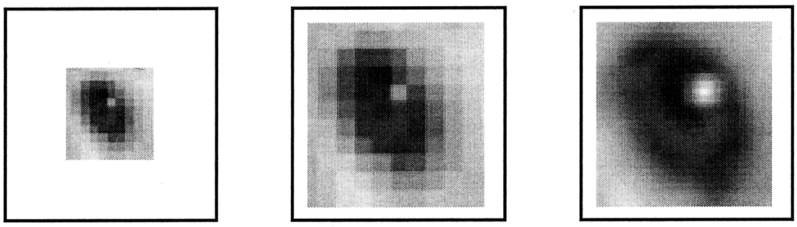
34. Harpreet is an experienced website creator. She uses a WYSIWYG editor rather than a text editor to create a website.

(*a*) Compare the use of a WYSIWYG editor and a text editor in producing the website, in terms of their demand on system resources. **2**

(*b*) As part of a graphic for the website, Harpreet scanned the image of an eye using 24-bit colour.

Describe how a scanner captures an image. Your answer must contain an appropriate level of technical detail. **3**

(*c*) After scanning, Harpreet scaled the eye and used *image manipulation software* to adjust the image.



Original scan | After scaling | After adjustment

(i) Name the feature of image manipulation software that Harpreet used to carry out the adjustment. **1**

(ii) Explain how this feature is able to improve the image of the eye. **1**

(iii) Name and describe a *compression technique* that would allow Harpreet to reduce the file size of the 24-bit colour eye without losing any image quality when it is decompressed. **2**

(*d*) Harpreet would like music to be playing in the background while each web page is being viewed. The music can either be stored as a MIDI file or a compressed MP3 file.

(i) Describe **one** way that the file size is reduced when saving a sound file as a compressed MP3 file. **1**

(ii) State **two** advantages of storing the music for Harpreet's web page using MIDI rather than MP3. **2**

SECTION III

Part C—Multimedia Technology (continued)

35. The logo for a transport system was created as an *SVG* graphic and is shown on the right

(*a*) SVG is an example of a *vector graphic* file type. Name **one** other vector graphic file type. **1**

(*b*) Explain why the above logo can be stored more **efficiently** as an SVG graphic than in the equivalent bit-map graphic. **1**

(*c*) Choose **one** of the objects in the metro logo above and show how it would be represented in SVG code.

Your answer should include the **name** of the object and at least **two** attributes. **2**

(*d*) A small part of the SVG code for the logo is shown below.

rgb(0,0,255)

(i) State which colour is represented by this code. **1**

(ii) The largest number that can be entered in to the **rgb** instruction shown above is 255.

Calculate the bit depth of that object. Show **all** working. **2**

(*e*) The logo was converted to *3D* and a *texture* applied to it.

Explain the term "texture" in relation to 3D graphics. **1**

(*f*) The logo was converted to a bit-map so it could be **animated.**

Name a bit-map format that would be suitable for storing the animated logo. **1**

[Turn over

SECTION III

Part C—Multimedia Technology (continued)

36. FoneSmart is releasing the latest version of their highly successful smart phone.

512 Mb Data Storage
MP3 Player
Voice Recording Function
Bluetooth & Firewire Enabled

(*a*) A multimedia presentation has to be designed and created for the launch of the latest version of the phone.

(i) State **two** elements that should be included in the **design** of a multimedia presentation. **2**

(ii) Describe **two** reasons why FoneSmart may wish to create the presentation in *multimedia authoring* software rather than *presentation* software. **2**

(*b*) The phone has a voice recording function. This allows the phone to record the user's voice using 8-bit mono sound at 22 kilohertz. The recording is then stored on a flash memory card.

(i) Calculate the file size of a 30 second voice recording. Express your answer in appropriate units. Show all working. **3**

(ii) Calculate how many of these 30 second voice recordings can be stored on a 512Mb flash card. Show all working. **1**

(iii) One of the advantages of using a flash card in the phone, rather than optical or magnetic storage, is its portability.

Describe **one** other advantage of using a flash memory card in the phone compared to optical or magnetic storage. **1**

(*c*) Voice recordings may be stored using either *PCM* or *ADPCM*.

(i) State **one** advantage of storing the recording using ADPCM compared to PCM. **1**

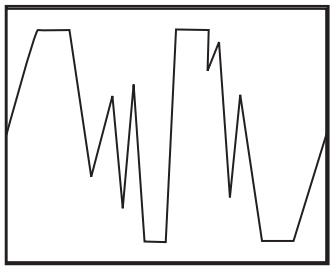
(ii) Describe how ADPCM stores sound data. **1**

SECTION III

Part C—Multimedia Technology (continued)

36. (continued)

(*d*) FoneSmart have received complaints that some voice recordings are unclear. The waveform of one of these recordings is shown on the right.



Explain why this recording is unclear. **1**

(*e*) Music files can be transferred to the phone by connecting the phone directly to a computer using either *Bluetooth* or *Firewire*.

(i) State **one** advantage of using "Bluetooth" rather than "Firewire" for transferring music files to the phone. **1**

(ii) State **one** disadvantage of using "Bluetooth" rather than "Firewire" for transferring music files to the phone. **1**

(*f*) Explain how this smart phone demonstrates *convergence of technology*. **1**

(*g*) FoneSmart are designing a new smart phone that will use *holographic storage*.

This phone will have a larger storage capacity and a faster data transfer rate than previous phones.

(i) Explain how holographic storage achieves a very high storage capacity. **1**

(ii) Explain how holographic storage achieves a very high data transfer rate. **1**

(50)

[*END OF SECTION III—PART C*]

[*END OF QUESTION PAPER*]

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