

X206/301

NATIONAL
QUALIFICATIONS
2010

THURSDAY, 3 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.

Part A	Artificial Intelligence	Page 10	Questions 18 to 22
Part B	Computer Networking	Page 16	Questions 23 to 26
Part C	Multimedia Technology	Page 20	Questions 27 to 31

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

Attempt all questions in this section.

1. Convert this *8-bit two's complement* binary number into a decimal.

11010011

1

2. Jane is concerned about a virus infecting her computer.
 - (a) *Watching* is one *virus code action*. Describe the term “watching”. **2**
 - (b) State **one** other virus code action. **1**

3. A *register* can be used to store a *memory address*. State the **two** other types of item that can be stored in a register. **2**

4. A new printer has 640 megabytes of RAM installed. State **one** reason why the printer has RAM installed. **1**

5. Complete the **two** missing stages of the *fetch-execute cycle*.

1	The memory address of the next instruction is placed on the address bus.
2	
3	The instruction is transferred to the processor on the data bus.
4	

2

6. Greg buys a single copy of a popular computer game. He then makes several copies to give out to his friends.
 - (a) State the name of the law that he has broken. **1**
 - (b) State **one** reason why making copies of the game is illegal. **1**

7. Explain **one** difference between a *Local Area Network (LAN)* and a *Wide Area Network (WAN)* in terms of *transmission media*. **2**

8. Describe **one** reason for connecting a network using a *switch* rather than a *hub*. **2**

SECTION I (continued)

9. Most high level languages have several *data types* available.

(a) State what is meant by a *real* variable. 1

(b) State the most suitable *data structure* and *data type* for storing the list called “valid” in the pseudocode shown below.

For each member of list

If gender(current) = “M” or gender(current) = “F” Then

Set valid(current) to true

Else

Set valid(current) to false

End If

End fixed loop 2

10. *Design* is the second stage of the software development process.

(a) Explain the importance of the design stage for one of the later stages in the software development process. Your answer should refer to the name of the stage that you have chosen. 2

(b) Describe how *stepwise refinement* can be used to help produce a detailed design. 2

11. Documentation is produced at **each** stage of the software development process.

(a) Name **one** item of documentation that is produced at the *implementation stage*. 1

(b) One purpose of creating documentation at **each** stage is to provide a starting point for the next stage.

State **one** other purpose of documentation. 1

(c) Describe the role that the programmer might play in the production of the *technical guide* during the *documentation* stage. 1

12. Software can be evaluated in terms of *efficiency* and *portability*.

(a) Software can be described as efficient if it does not waste memory.

Describe **one** way of making software efficient in terms of **memory usage**. 2

(b) Describe what is meant by the term “portability”. 2

SECTION I (continued)

- 13.** A sports centre has purchased software to assist with daily tasks such as bookings. The new software includes a *scripting language*.

State **one** use of a scripting language.

1
(30)

[END OF SECTION I]

SECTION II

Attempt all questions in this section.

14. Carolyn uses a computer to edit photographs that she has taken with her digital camera.
- (a) When Carolyn switches on her computer, system software in ROM finds and loads the operating system. Name this system software in ROM. **1**
- (b) Carolyn transfers the photographs from her camera to her computer using a *serial interface*.
- (i) Two functions of the interface are *data format conversion* and *handling of status signals*. Describe how each of these functions would be involved in this data transfer. **2**
- (ii) State **two** other functions of an interface. **2**
- Carolyn reduces the *bit-depth* of the photographs from 24 bits to 16 bits before saving the photographs onto the hard disk of her computer system.
- (c) (i) Describe **one** advantage of reducing the bit-depth of the photographs from 24 to 16. **2**
- (ii) Describe **one** disadvantage of reducing the bit-depth of the photographs from 24 to 16. **2**
- (iii) A 4 inch by 6 inch photograph with a resolution of 600 dpi and using 16-bit colour depth is stored. Calculate the file size of the photograph. **3**
State your answer using appropriate units. Show all your working.
- (d) Two functions of the operating system are *memory management* and *input/output management*. Describe the roles of each of these **two** functions when a photograph is saved on to the hard drive. **2**
- (e) Carolyn's camera uses *solid state storage*. Explain **one** reason why solid state storage is used in digital cameras. **2**
- (f) Carolyn uses photo editing software that allows her to store a photograph using *JPEG* or *GIF* file format. Describe **one** difference between these two file formats. **2**

[Turn over

SECTION II (continued)

15. Ernie has bought a new computer with 24 *control lines*, a 32-bit *address bus* and a 64-bit *data bus*.
- (a) Calculate the **maximum possible** amount of memory that Ernie's computer can address. State your answer using appropriate units. Show all your working. 3
 - (b) Ernie's computer has 16 megabytes of *cache* memory. Describe how the use of cache memory may improve system performance. 2
 - (c) Ernie requires new word processing software to use on his computer system. Describe **one compatibility issue** that should be considered when buying new software. 2
 - (d) Two methods of measuring performance are *application based tests* and *MIPS*.
 - (i) Explain why MIPS may be the better measure of **processor** performance than application based tests. 2
 - (ii) State **one** other measure of processor performance. 1
- Ernie's computer is part of a small *peer-to-peer network* of computers in his family home. There are three other computers in the house.
- (e) Explain **one** reason why the family created a *peer-to-peer* network instead of a *client-server* network. 2

SECTION II (continued)

16. Mrs Laird sets her Higher Computing class the task of writing a program that will take in three items – day, month and year. These three variables will have the same data type. The program will then output a “DateofBirth” variable with six characters, as shown below.

Input Variables		
day	month	year
15	Jun	1992

Output Variable
DateofBirth
150692

- (a) State the only *data type* that the pupils can use for **all three** of the “day”, “month” and “year” variables. Justify your answer. 2
- (b) Name the operation used to extract the last two characters from the contents of the “year” variable. 1
- (c) Part of the program will take the contents of **month** e.g. “Jun” and turn this into the corresponding **two** character value for that month e.g. “06”. Mrs Laird tells the pupils they must **not** use IF statements to implement this part of the program.
- Use pseudocode to design an algorithm for this part of the program. You should show only the first two months in your algorithm. 3
- (d) Name the operation used to join the three values together to produce the six characters for “DateofBirth”. 1
- (e) The contents of the “DateofBirth” variable are to be held in memory in ASCII format. Calculate the minimum amount of memory required to store the contents of this variable. 2
- (f) The pupils are using a *procedural* language to write their programs.
- (i) State **two** features of procedural languages. 2
- (ii) State **one** feature of *event-driven* languages that is **not** commonly found in procedural languages. 1
- (g) Mrs Laird tells the pupils that their programs must be easily *maintainable*. Describe **two** characteristics of a program that make it easily “maintainable”. 2
- (h) Mrs Laird also tells the pupils that they must avoid the use of *global variables* in their programs where possible.
- (i) State the meaning of the term “global variable”. 1
- (ii) Explain why the pupils have been asked to avoid the unnecessary use of global variables when programming. 2

[Turn over

SECTION II (continued)

17. Henry works for a company that maintains office buildings. He decides to write a program to print labels for the room keys in a new office block. The block has 38 floors, each with 25 rooms. The label will consist of the floor number and the room number. The design for the program is shown below alongside a sample section of output.

```

For each of 38 floors
  For each of 25 rooms
    Display "Floor Number:" and floor_no
    Display "Room Number:" and room_no
  Next room
  Display two blank lines
Next floor
    
```

```

Floor Number: 12
Room Number: 3

Floor Number: 12
Room Number: 4
    
```

- (a) Once the program has been written it must be translated. Describe clearly why using a *compiler* to translate the code produced from **this** algorithm would be more efficient in terms of **processor usage** than using an *interpreter* to translate the same code. 2
- (b) State **one** example of how text output from a program could be *formatted*. 1
- (c) The company decide to include Henry’s code as a new function in their building management software.
 State the **type** of maintenance being carried out on the building management software by adding this section of code as a subprogram. 1
- (d) In order for Henry’s program to operate correctly for **any** office building **two** parameters would have to be passed to it.
 (i) State what these **two** parameters would be. 2
 (ii) State whether these parameters would be passed to the subprogram by *value* or by *reference*. Justify your answer. 2
- (e) Another subprogram in the building management software is used to find the range of temperatures in a building in one day. The temperature is recorded every 15 minutes within a 24 hour period and stored in a list.
 Use pseudocode to design **one** algorithm to find **both** the **highest** and **lowest** temperatures in this list. 5

(60)

[END OF SECTION II]

SECTION III

Attempt ONE sub-section of Section III

Part A	Artificial Intelligence	Page 10	Questions 18 to 22
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For the sub-section chosen, attempt *all* questions.

SECTION III

PART A—Artificial Intelligence

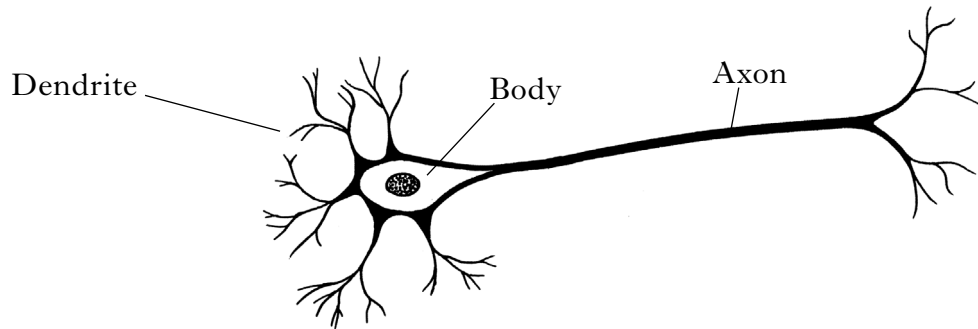
Attempt all questions.

18. Game playing is one area of research in *artificial intelligence*. Computers are being used in games such as chess and card games.
- (a) (i) State **one** meaning of the term “artificial intelligence”. **1**
- (ii) Name **one** popular test used to determine whether a computer system can be described as having artificial intelligence or not. **1**
- (iii) Explain why training computer systems to play simple games is thought to be a good way of investigating artificial intelligence. **2**
- (b) (i) One aspect of intelligence is *cognitive ability*. State **two** other aspects of intelligence that are used in game playing. **2**
- (ii) Describe how **each** of your answers in part (i) may be used in game playing. **2**
- (c) *Parallel processing* and *increased memory* have improved the performance of computers in game playing.
- (i) Describe how parallel processing can improve performance in games such as chess. **2**
- (ii) Describe how increased memory can improve performance in games such as chess. **2**

SECTION III

PART A—Artificial Intelligence (continued)

19. An area of artificial intelligence attempts to model systems based on the human brain. A diagram of a neuron found in the human brain is shown below.



- (a) Describe **one** similarity between an *artificial neuron* and a human neuron. 1
- (b) State **two** changes that can take place within an *artificial neural system* during the learning (or training) process. 2
- (c) In order to develop an artificial neural system a *restricted domain* should be identified.
- (i) Explain what is meant by the term “restricted domain”. 1
- (ii) State **one** other characteristic of a domain suitable for implementing as an artificial neural system. 1
- (d) The artificial neural system can be *hard-wired* or implemented as a *software model*.
State **one** advantage of implementing an artificial neural system as a software model instead of being hard-wired. 2
20. A company has developed a computer vision system to monitor swimmer safety in outdoor swimming pools. The system monitors activity in the pool using a number of cameras and will alert lifeguards to potential problems.
- (a) *Computer vision* consists of a number of stages.
- (i) Name and describe the **first** stage of computer vision. 2
- (ii) *Edge detection* will be used to analyse the image. Explain **one** problem for edge detection in **this** situation. 2
- (b) The cameras capture still images using **65536** colours. Calculate the *bit depth* of the images captured. 1

SECTION III

PART A—Artificial Intelligence (continued)

21. A student has created software about extinct animals for a museum. The software has a *knowledge base* with information about animals and the century in which they became extinct.

1 extinct(dodo seventeenth)
 2 extinct(sea_cow eighteenth)
 3 extinct(atlas_bear nineteenth)
 4 extinct(rice_rat twentieth)
 5 extinct(eastern_elk nineteenth)

The dodo became extinct in the seventeenth century.

6 older(seventeenth eighteenth)
 7 older(eighteenth nineteenth)
 8 older(nineteenth twentieth)

The seventeenth century is older than the eighteenth century.

9 earlier(A B) IF older(A B)

Century A is earlier than century B if century A is older than century B.

10 earlier(A B) IF older(A C) AND
 earlier(C B)

Century A is earlier than century B if century A is older than century C and century C is earlier than century B.

11 extinct_earlier(X Y) IF extinct (X A) AND
 extinct (Y B) AND
 earlier (A B)

Animal X became extinct earlier than animal Y if animal X became extinct in century A and animal Y became extinct in century B and century A is an earlier century than B.

- (a) State the solutions to the following query:

? extinct(X nineteenth)

2

- (b) When testing the knowledge base the student entered a query to identify the centuries that came before the twentieth century.

The solutions to the query were:

A = nineteenth
 A = eighteenth
 A = seventeenth

State the query that the student entered that resulted in this output.

3

SECTION III

PART A—Artificial Intelligence (continued)

21. (continued)

(c) Trace the **first** solution to the query:

```
? extinct_earlier(X sea_cow)
```

In your answer you will be given credit for the correct use of the term *sub-goal*. **6**

(d) *Negation* is implemented in Prolog by the use of *NOT*. Describe the effect of *NOT* in the evaluation of a query. **1**

(e) The knowledge base could have been represented using a *semantic net*.

(i) Draw a simple semantic net of the fact at line 7. **2**

(ii) Use your diagram to explain how a semantic net is used to represent knowledge. **2**

(f) The student chose to implement the software using a *declarative* language rather than a *procedural* language.

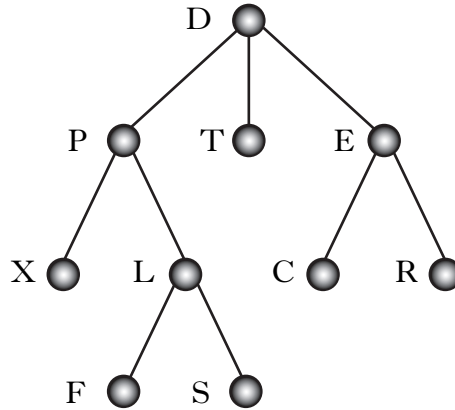
One reason for this choice was the facility to use *facts* and *rules*. State **one** other reason for choosing a declarative language. **1**

[Turn over

SECTION III

PART A—Artificial Intelligence (continued)

22. A search tree is shown below. The goal state is represented by the node C.



Depth-first and *breadth-first* are search techniques that may be used to find the goal state.

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

- (b) (i) State **one** advantage of using **depth-first** when compared to breadth-first to search the tree. 1
- (ii) State **one** advantage of using **breadth-first** when compared to depth-first to search the tree. 1

- (c) (i) State which one of these two search techniques makes use of *backtracking*. 1
- (ii) Explain how the search technique named in part (c) (i) employs backtracking when searching the tree shown above. 2

- (d) The most *efficient* search would visit the nodes in the order **DEC**. This would use a *heuristic search*. 3
- Describe how a heuristic search finds the nodes in the path **DEC**. 3

(50)

[END OF SECTION III—PART A]

[Turn over for Question 23 on *Page sixteen*

SECTION III

PART B—Computer Networking

Attempt all questions.

23. The manager of the Sea Bay Hotel has created a website to display details of the hotel and allow customers to make online bookings.

She hopes that this will cut down on the number of errors in bookings, such as double-booking and employees entering the wrong details for bookings.

- (a) The web address for the Sea Bay Hotel is:

www.seabayhotel.co.uk

A user enters this web address into a browser. Describe how the *domain name server* uses the web address to access the website.

3

- (b) Online hotel booking systems may be subject to additional problems such as hacking and credit card fraud.

Name and describe **one** other possible illegal activity that the hotel could suffer from as a result of allowing customers to book and pay online.

2

- (c) The hotel uses an intranet with ten computers, two printers and a scanner connected to it.

State the most suitable class of *IP address* for this network. Justify your answer.

2

- (d) The manager is concerned about employees accessing unsuitable websites from the hotel's computers.

(i) Describe how *Internet filtering software* would prevent employees from accessing unsuitable websites.

1

(ii) Describe how a *walled garden* would prevent employees from accessing unsuitable websites.

2

- (e) Despite these precautions, the manager suspects that an employee is accessing websites containing illegal material.

State **two software** actions that the *Regulation of Investigatory Powers Act* would allow the police to undertake.

2

- (f) The Sea Bay Hotel website can be found by using a *search engine*. A search engine can use either a *spider* or a *meta-search*.

Describe how **each** of these two methods is used by a search engine.

2

SECTION III

PART B—Computer Networking (continued)

23. (continued)

(g) Some of the *HTML* coding for the hotel website is shown below.

```
<html>
<head>
<title><i>Sea Bay Hotel Home Page</i></title>
<body>
<center><h1>Sea Bay Hotel</h1></center>
<p>Welcome to the Sea Bay Hotel</p>
</body>
</htm>
```

Identify **two** errors that are present in the above HTML code. 2

(h) Describe **two** changes that could be made to the HTML code of the webpage to increase the number of hits by a search engine, once the above errors have been corrected. 2

(i) The manager is worried about *viruses*. *Anti-virus software* has been installed on all of the hotel computers.
Name and describe **one** class of virus that the anti-virus software might detect. 2

24. Legends is a catering company that owns 130 restaurants nationwide. Each restaurant is connected to the head office through a Wide Area Network (WAN) to allow communication and file sharing.

- (a) The network uses *CSMA/CD*.
- (i) Describe how CSMA/CD operates. 4
 - (ii) State **one** way in which CSMA/CD **reduces** network performance. 1
- (b) The TCP/IP protocol uses *packet switching* when transmitting files over the network. Explain **one** advantage of packet switching over *circuit switching* when transmitting files over a network. 2

[Turn over

SECTION III

PART B—Computer Networking (continued)

25. Bishopsland High School has its computers connected in a Local Area Network (LAN). The network is connected using cables.
- (a) The network conforms to the *Open Systems Interconnection* (OSI) model.
Two layers of the OSI model are the *Session layer* and the *Network layer*.
- (i) State **one** task carried out at the Session layer. **1**
- (ii) Name a networking device that operates at the Network layer. **1**
- (b) Data can be sent over a network using *synchronous* or *asynchronous* data transmission.
Explain **one** advantage of synchronous compared with asynchronous data transmission. **2**
- (c) A 200 megabyte file is to be downloaded at 100 megabits per second.
Calculate how many seconds it will take to download the file. Show all working. **2**
- A pupil has suggested that a wireless network would be better than the current cable network.
- (d) (i) Name a **hardware** device that must be present in a computer to enable it to connect to a wireless network. **1**
- (ii) Explain the function of this device. **1**
- (e) State **two** disadvantages of converting to a wireless network compared to using cables. **2**
- (f) The school network has been subject to a *denial of service* attack.
Describe **one** method of using software to carry out a denial of service attack. **1**
- (g) The school is situated in a remote area that was previously considered *Information Poor*.
- (i) Describe **one** way that the pupils may now be *Information Rich*. **1**
- (ii) Explain **one** social implication of the change to Information Rich. **1**

SECTION III

PART B—Computer Networking (continued)

26. When data is transmitted across a network, it is important that error checking takes place.
A *parity check* and a *cyclic redundancy check* are two methods of error checking.
- (a) Explain why a cyclic redundancy check is more effective than a parity check. **2**
- (b) *Error checking* improves the **integrity** of data passing through the network.
Explain **one** way that error checking may **reduce** the performance of the network. **2**
- (c) The network must be able to avoid catastrophic failure. Describe **two** software *disaster avoidance* techniques that could be used to make the network less prone to failure. **2**
- (d) If the disaster **avoidance** techniques fail, the network may crash. A *backup server* and *mirror disks* are both *backup strategies* that could be used to **recover** from this disaster.
- (i) Describe **one** benefit and **one** drawback of using a backup server as a disaster recovery strategy. **2**
- (ii) Describe **one** benefit and **one** drawback of using a mirror disk as a disaster recovery strategy. **2**
- (50)**

[END OF SECTION III—PART B]

SECTION III

PART C—Multimedia Technology

Attempt all questions.

27. Two photographs are to be used as the basis for an animation. A digital camera is used to take the photographs.



- (a) Describe in detail how an image is captured and converted into a digital format by the camera. 3
- (b) Each frame in the completed 12 second animation is held as a GIF with a resolution of 640×480 pixels. The animation has a frame rate of 24 frames per second.
- Calculate the file size of the animation before compression. State your answer using appropriate units. Show all working. 4
- (c) The animation is tested on different computers and the colours displayed in the animation vary slightly.
- (i) State which software technique could reduce this colour variation problem. 1
- (ii) Explain how this technique reduces this colour variation problem. 2
- (d) The animation files are compressed using LZW. Describe how the *LZW compression technique* compresses files. 2

SECTION III

PART C—Multimedia Technology (continued)

28. A DJ has connected a record turntable to his computer to transfer tracks from his vinyl record collection to his computer.



- (a) Describe **one** function of the *sound card* **during** the transfer of the data to the computer. 1
- (b) The DJ wants to store the tracks with no loss of sound quality.
State a suitable file format for storing the tracks without losing sound quality. 1
- (c) Clips from several tracks are combined into a single file, but one of the clips is too quiet and another is too loud.
- (i) State the technique that should be used to solve this problem. 1
- (ii) Describe how your answer to part (i) solves the problem. 2
- (d) The completed track plays for 5 minutes and is 16 bit stereo with a sampling rate of 44.1 KHz.
Calculate the uncompressed file size of this track. State your answer using appropriate units. Show all working. 3
- The DJ often uses *surround sound* in his shows.
- (e) Explain **one** advantage of surround sound over stereo. 2
- The DJ has stored several tracks as *MIDI* files.
- (f) Describe how individual notes are stored in the MIDI file format. 2
- (g) Describe **one** benefit of using the MIDI file format to store tracks used with surround sound. 2

[Turn over

SECTION III

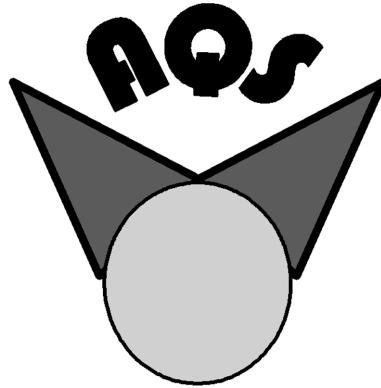
PART C—Multimedia Technology (continued)

29. The developers of a new digital video camera have to decide which communication interfaces to include in the camera.
- The video camera is to be suitable for *streaming* live video.
- (a) Explain **one** reason why a *Bluetooth* interface is unlikely to be chosen for streaming live video. 2
- (b) (i) Recommend the most suitable type of interface for this situation. 1
(ii) Justify your choice in part (i). 2
- (c) State why it would be an advantage to have *hardware codecs* built in to the video camera rather than loading in the software. 2
30. A museum uses multimedia presentations to provide information about various exhibits.
- The software that was used to develop the presentations has a *WYSIWYG* interface.
- (a) Explain **two** reasons why *WYSIWYG* would help the developer during the implementation stage. 2
- All of the presentations include links to video clips. The video clips are stored in either *MPEG* or *AVI* format.
- (b) Describe how files are stored in the *MPEG* format. 3
- (c) *AVI* does not allow compression but has been chosen for some short clips that are displayed in small windows.
- Explain why the *AVI* format is suitable for storing these video clips. 2
- Some of the presentations are made available for downloading from the museum website.
- (d) (i) Explain why a *container file* would be used to store the presentations. 2
(ii) Describe **one** problem that may be encountered when using a container file. 1
- To improve the display of the presentations, the museum upgrades the *graphics cards* on its computers.
- (e) Other than converting signals, state **two** ways a graphics card assists the processor when displaying graphics. 2

SECTION III

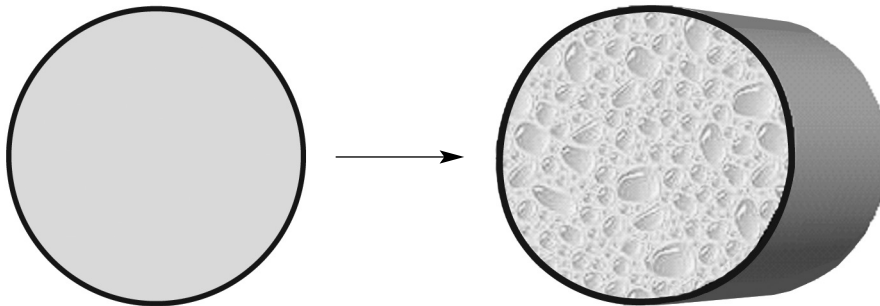
PART C—Multimedia Technology (continued)

31. The logo shown is stored as an *object oriented* graphic.
The logo appears in a variety of sizes on both printed documents and monitors.



- (a) Describe **two** advantages of storing the graphic in *object oriented* format rather than *bitmapped* format. 2

One object in the logo is a circle. The circle is altered so that it is shown in 3D.



- (b) Name **two** additional attributes that require to be stored to create the 3D representation shown. 2
- (c) Name a suitable file format for the 3D logo. 1

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[END OF SECTION III—PART C]

[END OF QUESTION PAPER]

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