

X206/12/01

NATIONAL
QUALIFICATIONS
2012

THURSDAY, 31 MAY
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 12	Questions 23 to 27
Part B	Computer Networking	Page 18	Questions 28 to 31
Part C	Multimedia Technology	Page 22	Questions 32 to 35

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. Write the ten digit binary number **1001001001** as a positive integer. **1**

2. A computer system uses *floating point representation* to store *real* numbers.
 - (a) State the part of floating point representation that determines the **range** of numbers stored. **1**

 - (b) State the part of floating point representation that determines the **precision** of numbers stored. **1**

3. Ali has created a poster using *bitmapped* graphic software. Describe how a bitmapped graphic is stored. **2**

4. *Protocol conversion* and *buffering* are two functions of an interface. State **two** other functions of an interface. **2**

5. The table shows types of computer memory listed in **descending** order of *speed of access*, (fastest first). Identify the **two** missing types (1) and (3).

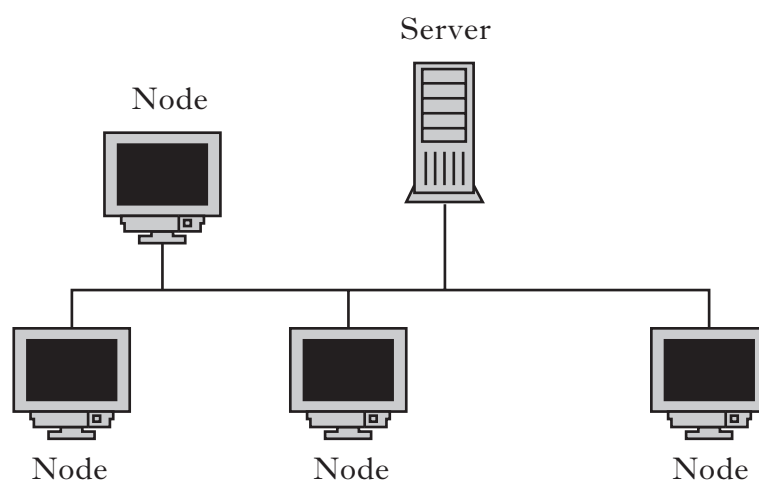
(1)	
(2)	Cache
(3)	
(4)	Backing store

2

6. Audrey creates and saves a new document to the hard disk.
 - (a) State **two** tasks carried out by the *file management* part of the operating system during this save operation. **2**

 - (b) State **one** task carried out by the *input/output management* part of the operating system during this save operation. **1**

7. The diagram below shows the layout of a small LAN.



- (a) Name this network *topology*. 1
- (b) The network shown above is a *client server* network. State **one** advantage of a client server network over a *peer-to-peer* network. 1
- (c) A device is required to connect this network to the Internet. Name this device. 1
8. The software development process is *iterative*. Explain how the word iterative applies to this process. 2
9. Many software development projects use *top-down design*. Explain the process of top-down design. 1
10. Name **one** *graphical design notation*. 1
11. An *interpreter* may be used in the software development process.
- (a) Name **one** stage of the software development process where the interpreter may be used. 1
- (b) Explain how the interpreter is used in the stage named in part (a). 1
12. Describe **one** difference between a *scripting* language and a *procedural* language. 2

SECTION I (continued)

13. (a) State what is meant by a *boolean* variable. 1
- (b) Explain how a boolean variable could be used in a *linear search* algorithm. 1
14. Software should be both *reliable* and *robust*. Explain the terms “reliable” and “robust”. 2
15. State **one** way in which documentation produced at the *testing* stage of the software development process will be used during *corrective* maintenance. 1
16. State **two** characteristics of programming code that improve *maintainability*. 2
- (30)

SECTION II

Marks

Attempt all questions in this section.

17. Tara, who works for Consumer Friend Magazine, has produced the following table.

Consumer Friend Magazine				
Processor	Clock Speed (GHz)	MIPS	MegaFLOPs	Data Bus Width (Bits)
Inrel Core Gi	3.2	72,495	63,933	64
Atheton E	2.8	73,665	63,105	64
Motorilla T	2.0	49,924	51,150	128

NOTE: One MegaFLOP = One Million FLOPs

- (a) Explain why clock speed alone is not considered a good measure of **processor** performance. 1
- (b) Tara states that the Atheton E is better than the Inrel Core Gi as it has a higher MIPS result. Explain why Tara may be incorrect. 2
- (c) A computer containing the Motorilla T has a 32 bit address bus, a 128 bit data bus and 24 control lines. Calculate the maximum addressable memory of this computer.
Show all working. State your answer using appropriate units. 3
- (d) All processors contain an *ALU* and a *control unit*.
- (i) State **one** logic operation performed by the ALU. 1
- (ii) Describe the purpose of the control unit. 1
- (e) The manufacturers of the Inrel Core Gi are considering using a wider data bus in a new processor design. State **one** reason why this will improve processor performance. 1

[Turn over

SECTION II (continued)

Marks

- 18.** A system called EarthWatch gathers data from weather stations all over the world. Each station uses a *terminal* to enter data into the EarthWatch *mainframe*.
- (a) Apart from the physical size or the cost of a mainframe, explain **one** difference between a mainframe with terminals and a network of computers. **2**
- (b) The mainframe's hard disk system has been continually storing weather data for 5 years. A message appeared on the main screen stating that the data file could not be stored on the hard disk due to lack of storage space. However there is enough space on the mainframe's hard disk system.
- (i) Explain the **most likely** cause of this apparent lack of storage. **2**
- (ii) Name a piece of software which could solve the problem identified in (i). **1**
- (iii) State the **class** of software that the item named in (ii) belongs to. **1**
- (c) Each EarthWatch weather station contains 10 terminals connected to a file server situated 80 metres from the terminals. State a suitable transmission medium to connect the terminals to the server. Explain your reasoning. **2**
- (d) The EarthWatch mainframe performs many memory read operations per second. Write down the steps involved in a single memory read operation. Name the *bus* or *control lines* involved at each step. **3**

SECTION II (continued)

Marks

- 19.** Harry is an expert on human linguistics. He is currently studying a **data file** on his computer containing 3000 ancient Chinese characters.
- (a) State whether this file is an *ASCII* file or a *UNICODE* file. Explain your reasoning. 2
- (b) Harry buys a printer to print the characters. Apart from cost, name **two** other relevant characteristics of a printer. 2
- (c) Harry is concerned that this data file may contain a *file virus*.
- (i) Explain whether Harry's concern is justified. 2
- (ii) State what is meant by a computer virus. 1
- (iii) State **one** action of a virus. 1
- (d) Harry saves a picture of each character in GIF format. State **two** characteristics of the GIF format. 2

[Turn over

SECTION II (continued)

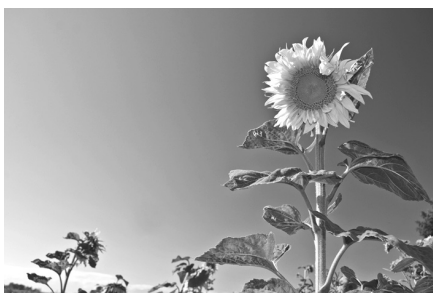
Marks

20. Martin is a systems analyst. He has just been given a new project to work on.
- (a) (i) Explain why Martin will interview the client during the *analysis* stage. **1**
 - (ii) State **two** other techniques that Martin may use during the analysis stage. **2**
 - (b) Martin is responsible for producing a document at the **end** of the analysis stage.
 - (i) Name this document. **1**
 - (ii) State **two** reasons why this document has to be agreed with the client before it is finalised. **2**
 - (c) Explain how a systems analyst could be involved in the **testing** stage of a project. **1**
 - (d) When Martin was at University, he earned money by being part of *independent test groups*. Explain why he cannot be part of the independent test group assigned to **this** project. **1**
 - (e) Effective testing of the software needs to be both *systematic* and *comprehensive*. Explain the terms “systematic” and “comprehensive”. **2**
 - (f) Towards the end of the project, Martin is told that the project is running over budget. State the **job title** of the person who has the responsibility for the project budget. **1**

SECTION II (continued)

Marks

21. Over the summer, a garden centre has been running a “tallest sunflower” competition.



Entrants have completed an online entry form to provide their name and the height of their sunflower. These have been collated into two lists. Samples from these lists are shown below.

Name of entrant
Eildih Brown
Helen Atkins
Mark Ames
Jenna Wylie

Height of sunflower (metres)
2.15
1.79
2.32
1.41

- (a) State the *data structure* and *data type* used to store the list of heights. 2
- (b) Using *pseudocode*, design an algorithm to find and display the **name** of the person growing the tallest sunflower. 6
- (c) The garden centre wants to give a consolation prize to the grower of the **shortest** sunflower. A number of changes need to be made to the pseudocode you wrote in part (b).
- (i) State **one** change that you would make to your pseudocode from part (b). 1
- (ii) Explain **why** this change is necessary. 1

[Turn over

SECTION II (continued)

Marks

22. A travel agent uses a suite of software to help advertise holidays and make bookings. Part of the pseudocode that was written for the software is:

```
if cost per person is less than 500
    set band to 'cheap'
end if
if cost per person is greater than or equal to 500 AND cost per person is less than 2000
    set band to 'medium'
end if
if cost per person is greater than or equal to 2000
    set band to 'expensive'
end if
```

- (a) By using a holiday cost per person of £495, explain why this pseudocode would not produce *efficient* code. 2
- (b) Show how these lines could be rewritten in a more efficient way. 2
- (c) When the above is implemented as a subroutine, state whether the variable “cost per person” would be passed by *reference* or *value*. Justify your answer. 2

Each holiday booking is assigned a unique reference code. The software which creates this code uses *concatenation* within a *user-defined function*.

- (d) Explain the term *concatenation*. 1
- (e) Explain the term *function*. 2

(60)

[END OF SECTION II]

SECTION III

Attempt one sub-section of Section III.

Part A Artificial Intelligence	Page 12	Questions 23 to 27
Part B Computer Networking	Page 18	Questions 28 to 31
Part C Multimedia Technology	Page 22	Questions 32 to 35

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

PART A — Artificial Intelligence

Attempt all questions.

23. The Turing Test can be used during the development of *chatterbots*.
- (a) State the purpose of the Turing Test. 1
- (b) Describe how a chatterbot attempts to have a meaningful conversation. 2
- (c) State **two** weaknesses that may be present in a chatterbot's conversation with a human. 2
- (d) State **one** improvement in processors and describe how it improves the performance of a chatterbot. 2
24. The water jugs puzzle is a well known artificial intelligence problem. In this puzzle there are two jugs; the jug on the left holds three litres and the one on the right holds five litres. Neither has any measuring markers on it. There is a tap that can be used to fill the jugs with water. The goal of the puzzle is to measure exactly four litres of water.



A computer is used to find a solution.

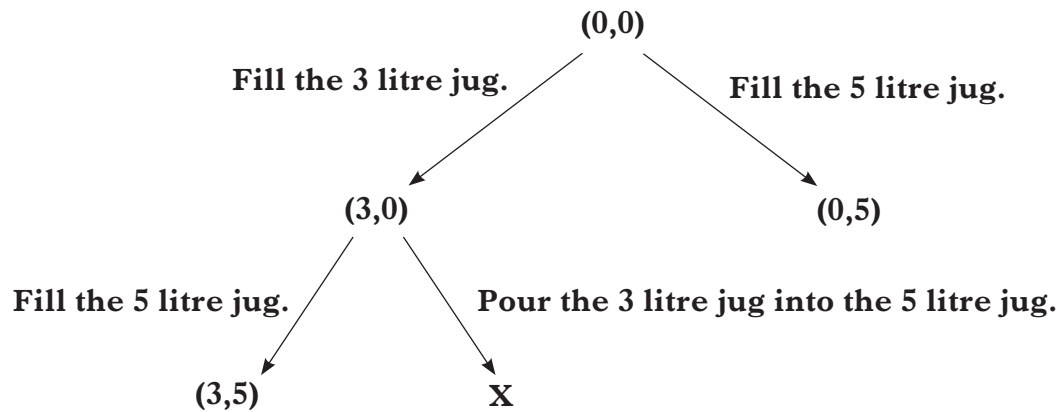
- (a) State the aspect of intelligence which a computer is demonstrating when finding the solution to the water jugs puzzle. 1
- (b) Some people would argue that a computer solving this puzzle does **not** have artificial intelligence.
- State **one** reason which supports this opinion. 1

PART A — Artificial Intelligence (continued)

24. (continued)

The computer represents both jugs being empty as (0,0). The node (3,0) means that the three litre jug on the left is full and that the five litre jug on the right is empty.

It attempts to solve the puzzle by generating the following states:

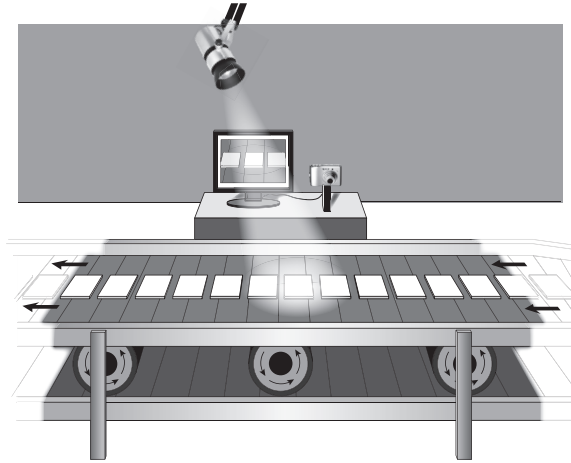


- (c) Name this type of diagram. 1
- (d) The order of nodes currently in memory is (0,0), (3,0), (0,5) and (3,5).
Explain which *search technique* is being used. 2
- (e) State **two** other search techniques that could be used. 2
- (f) State the node missing from the diagram, marked by the letter X. 1
- (g) The diagram shows three of the possible moves:
- Fill the 3 litre jug
 - Fill the 5 litre jug
 - Pour the 3 litre jug into the 5 litre jug.
- State **two** other possible moves. 2

[Turn over

PART A — Artificial Intelligence (continued)

25. CeramicSee is a vision system that is used in the quality control of ceramic tiles.



CeramicSee rejects tiles with flaws such as:

- wrong shade or colour
- physical damage such as chips or scratches.

- (a) Describe **two** ways in which CeramicSee overcomes common problems with vision systems. 2
- (b) The *image acquisition* stage of CeramicSee uses a digital camera capable of 32 bit colour to capture an image of a tile. Calculate the maximum number of different colours in an image. 1
- (c) Name and describe **two** other stages of computer vision. 4
- (d) CeramicSee uses an *artificial neural system* to identify defective tiles. Describe how *weights* are used in the **training** of an artificial neural system. 3
- (e) State **another** example of an application that uses an *embedded* vision system. 1

PART A — Artificial Intelligence (continued)

26. Intelligent robots are one application of artificial intelligence. This has resulted in the development of robots for household tasks particularly floor cleaning.



Floor cleaning robot

- (a) State what is meant by the term “artificial intelligence”. 1
- (b) State **one** characteristic of an intelligent robot when compared to a dumb robot. 1
- (c) Describe **two practical** difficulties associated with the development and use of an intelligent robot for floor cleaning. 2
- (d) (i) State **one** legal implication of the use of an intelligent robot. 1
- (ii) Explain how a manufacturer of robots can address legal implications. 1

[Turn over

PART A — Artificial Intelligence (continued)

27. An online multi-player game has been created. Each player in the game is a character such as a troll or an orc that can acquire various objects as they move through the game eg a sword or armour. A character can only defeat another if they have the correct object.

This knowledge base stores the current state of the game:

- | | |
|--|---|
| 1. has_found(troll jewel). | <i>The troll has found a jewel.</i> |
| 2. has_found(troll sword). | |
| 3. has_found(orc armour). | |
| 4. has_found(druid potion). | |
| 5. has_found(druid lance). | |
| 6. is_weapon_against(lance troll). | <i>The lance is the weapon to use against a troll.</i> |
| 7. is_weapon_against(sword orc). | |
| 8. is_weapon_against(jewel troll). | |
| 9. life_points(troll 1000). | <i>The troll has 1000 life points.</i> |
| 10. life_points(orc 200). | |
| 11. life_points(druid 140). | |
| 12. stronger_than(X Y) IF life_points(X A) AND
life_points(Y B) AND
A>B. | <i>Character X is stronger than character Y if X has life point A and character Y has life points B and A is greater than B.</i> |
| 13. can_defeat(X Y) IF has_found(X Z) AND
is_weapon_against(Z Y) AND
not(X=Y). | <i>Character X can defeat character Y if character X has found item Z and Z is the weapon against character Y and character X is not character Y.</i> |

(a) State the solution to the following query:

? has_found(X potion)

1

(b) State the query required to find the weapons that can be used against the troll.

2

PART A — Artificial Intelligence (continued)

27. (continued)

(c) Explain how the following query would be evaluated:

? not(life_points(troll 800))

2

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

? can_defeat(troll Y)

In your answer you will be given credit for the correct use of *backtrack*.

8

(e) The original software specification stated that a player can defeat an opponent if the player has found the appropriate weapon for that opponent and that they are stronger than the opponent.

(i) The existing rule 13 must have **one** line added to meet this requirement.

can_defeat(X Y) IF has_found(X Z) AND
is_weapon_against(Z Y) AND
not(X = Y) AND

.....

State the missing line of the new rule.

2

(ii) State the **type** of maintenance that this change to the software is best described as.

1

(50)

[END OF SECTION III—PART A]

[Turn over

SECTION III

Marks

PART B — Computer Networking

Attempt all questions.

28. It is important that computer networks are designed to agreed standards, such as the Open Systems Interconnection (OSI).
- (a) (i) State the name of the *layer* of the OSI model at which a *router* functions. 1
- (ii) State the name of the *layer* of the OSI model that carries out *data encryption*. 1
- (b) *TCP/IP* is a set of protocols used in network communication. State the actions carried out by the **IP** part when transmitting data over a network. 2
- (c) Explain how *CSMA/CD* improves network performance. 2
- (d) The byte of data below is transmitted across a network. It contains a *parity* bit.

1000 1111

- State which **kind** of parity was used when sending this data. Justify your answer. 2
- (e) Data can be sent *synchronously* or *asynchronously*. State which of these methods uses start and stop bits and how it uses them. 2

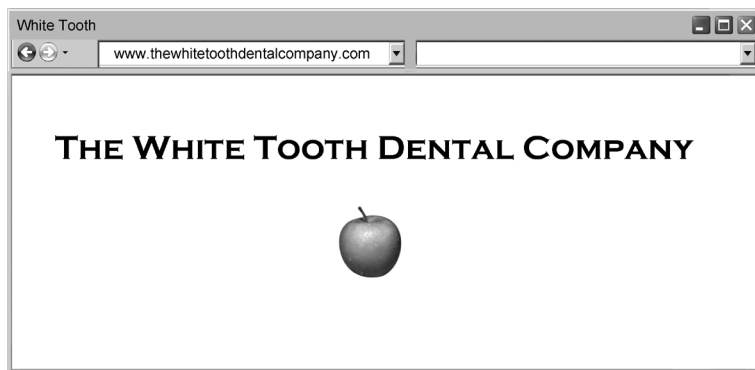
PART B — Computer Networking (continued)

29. A local dentist has created a cabled network to connect his four computers and a printer.

(a) Explain why the dentist chose to use cables rather than wireless to connect the network. 1

(b) The dentist is worried that a hacker may get access to his patient files without his knowledge. Name the **type** of attack that the dentist is worried about. 1

A website is being created for the dentist using *HTML* as shown below.



(c) Write the *HTML* code for the **title tag** of this webpage. 2

(d) The apple image displayed on the web page was captured in *true colour*. State what is meant by “true colour”. 1

(e) The website is published on the Internet. However, the dentist realises that search engines are not finding his website.

(i) State an additional element that should be included in the *HTML* code in order to help a search engine find the website. 1

(ii) Name the section of the *HTML* code in which this element should be placed. 1

(f) The dentist would like the website to be viewed on mobile phones. The *HTML* code will have to be re-written in a different language.

(i) Name the language required to create webpages for mobile phones. 1

(ii) State the protocol that allows mobile phones to access the website. 1

(iii) State **one** other type of device that uses this protocol. 1

(g) After testing the mobile phone version of the website, an error was found. State the type of *maintenance* required to fix errors not identified during testing. 1

SECTION III

Marks

PART B — Computer Networking (continued)

30. A teacher requires a username and password to give her remote access to her school server.
- (a) Other than *TCP/IP*, name a protocol which could allow remote access to a server. 1
 - (b) The school's server has been subjected to a *denial of service (DOS) attack*.
 - (i) Describe **one** possible denial of service attack. 2
 - (ii) State **two financial** implications for the school as a result of this DOS attack. 2
 - (c) The school's server has a *firewall*. State **two** ways that a firewall could be used to monitor access to the school network. 2
 - (d) Hacking is a **security** issue that the school will have to consider. Other than a firewall, describe **two** software methods that the school could employ to try to prevent hackers from gaining unauthorised access to their server. 4
 - (e) The school is concerned about accidental or malicious loss of data from their server. They have installed a *mirror disk*. Explain how a mirror disk would help them in this situation. 2
 - (f) The school is concerned about staff and pupils accessing websites from school computers.
 - (i) Explain how a *walled garden* would prevent staff and pupils from accessing unsuitable websites. 2
 - (ii) Describe **one** way that *Internet filtering* software differs from a walled garden. 1
 - (g) The teacher creates a *WPAN* to connect her laptop, printer and smartphone. Explain **one** reason why a *WPAN* would be appropriate for this network. 1

SECTION III

Marks

PART B — Computer Networking (continued)

31. A sports centre has a local area network of 10 computers and 2 printers.
- (a) Explain why *class A IP addressing* is **not** suitable for this network. 1
- (b) A network interface card is required to provide a physical link to the local area network. The network interface card contains a *MAC* address. Describe the purpose of a *MAC* address. 1
- (c) When data is transmitted across the network a *Cyclic Redundancy Check (CRC)* is carried out. Describe how the **receiving** device uses *CRC*. 3
- (d) The sports centre has a website which allows bookings to be made and paid for online. Members have expressed some security concerns about using their credit cards to pay for bookings online.
- (i) Explain how *packet switching* would increase the security of the transmitted data. 2
- (ii) The sports centre's network can also set up a direct communications link to their head office. State the method of switching which would set up this direct link. 1
- (e) The sports centre has an *ADSL* connection to the Internet.
- (i) The manager wants to download a 150 Megabyte file. The *ADSL* connection has a download speed of 8 Megabits per second. Calculate the time taken to download this file. Show all working. 2
- (ii) When the file was downloaded it took longer than the time calculated in part (i). Suggest **two** reasons for this increase in download time. 2
- (50)

[END OF SECTION III—PART B]

[Turn over

SECTION III

Marks

PART C — Multimedia Technology

Attempt all questions.

32. Peter is a guitar teacher who uses his website to give pupils access to audio files. The audio files are instrumental tracks for practice between lessons.

(a) (i) The audio files are stored in the *MIDI* format. One benefit of this file format is its small size. State **two** other benefits of using the MIDI file format. 2

(ii) MIDI files are stored using *sound attributes* such as *duration* and *tempo*. Describe the terms “duration” and “tempo”. 2

(b) State **two** reasons why the pupils may prefer the *MP3* file format to the MIDI file format. 2

Peter has demonstration video clips on his website.

(c) The video clips were originally taken using a resolution of 1024×768 with a frame rate of 25 fps. Calculate the file size of an uncompressed 24 bit video clip which plays for 64 seconds. Show all working. State your answer in megabytes. 3

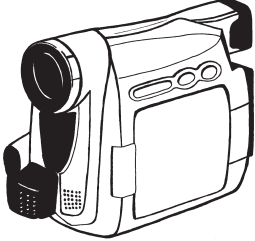
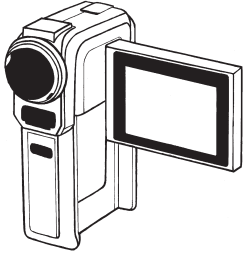
Pupils must *stream* the video clips to their computer when viewing.

(d) Peter is worried about breach of copyright. Explain how **streaming** will help avoid this. 1

(e) Assuming there are no hardware or software problems, explain why streamed video may pause when viewed on a pupil’s computer. 2

PART C — Multimedia Technology (continued)

33. EasyVid manufactures video cameras. The EasyVid Super4 digital video camera will be a new digital video camera designed to replace the current EasyVid Power3 digital camera.

	<p style="text-align: center;">EasyVid Power3</p> <p>4.1 megapixels Bluetooth & Firewire enabled 40 Gb hard disk Video editing software supplied</p>
	<p style="text-align: center;">EasyVid Super4</p> <p>12 megapixels Bluetooth & USB 3.0 enabled Built-in hardware codecs Built-in 3 in 1 card reader Video editing software supplied</p>

- (a) State **two** advantages USB 3.0 has over Firewire. 2
- (b) It had been suggested that the EasyVid Super4 should be WiFi enabled. The manufacturer decides **not** to add a WiFi interface. State **one** reason other than cost to support their decision. 1
- (c) The EasyVid Super4 has no hard disk. Explain why using removable solid state storage would extend battery life. 2
- (d) The manufacturer has built in hardware *codecs* to the EasyVid Super4. Describe **one** advantage and **one** disadvantage to the user of a hardware codec rather than a software codec. 2
- (e) Video editing software is provided with both cameras. This includes *transition features*.
- (i) Explain what is meant by a “transition feature”. 1
- (ii) Name and describe **one** effect usually available as a transition. 2
- (f) Explain why neither camera uses an *ADC* during data transfer to a computer. 1

[Turn over

PART C — Multimedia Technology (continued)

34. The Bestview Camera Club has an annual photographic competition. Presentation software is used to display the entries as a slide show.

- (a) A design technique suitable for planning the presentation is storyboarding. Describe **two** features of a storyboard that should be included in the design of the presentation. 2

Spoken comments about entries are to be recorded for inclusion in the slide show.

- (b) Calculate the **uncompressed** file size of an 8 bit, 24 second stereo recording sampled at 11 kHz. Show all working. State your answer in appropriate units. 3

The WAV file format is used to store the spoken comments. WAV files are compressed.

- (c) (i) State the name of the compression method used. 1
 (ii) Describe **how** this method achieves compression. 2
- (d) Describe how the file size of a spoken comment could be significantly reduced without changing the sampling depth. 1

A short musical introduction is used at the start of the slide show. Figure 1 shows the waveform of the introduction. Figure 2 shows the waveform after an effect has been applied.

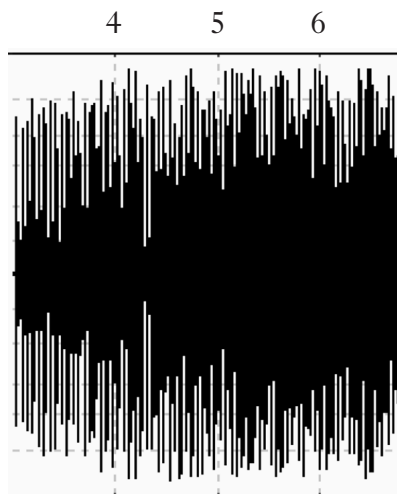


Figure 1

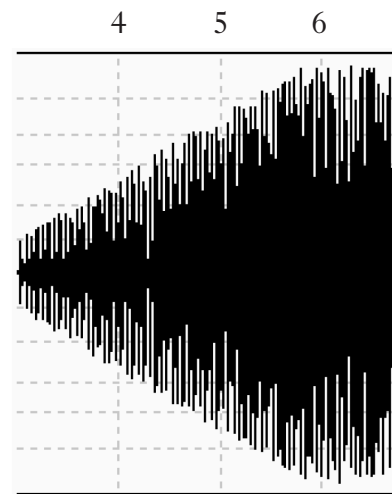


Figure 2

- (e) State the effect applied to the sound. 1

SECTION III

Marks

PART C — Multimedia Technology (continued)

34. (continued)

(f) During testing of the slide show, it is noted that one audio file has been *clipped*.

- (i) Explain the term “clipping”. You **must** include a diagram in your explanation. 2
- (ii) Describe how *normalisation* would have avoided the problem of clipping. 2
- (iii) Describe **one** disadvantage of normalisation. 2

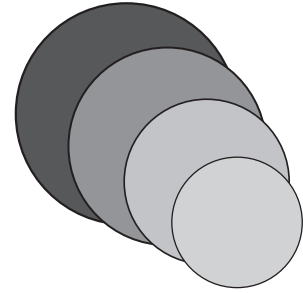
[Turn over for Question 35 on *Page twenty-six*

SECTION III

Marks

PART C — Multimedia Technology (continued)

35. A designer has stored a graphic in each of *GIF*, *PNG* and *SVG* formats.



- (a) The designer notices that adding each circle to the graphic increases the file size of the SVG file but **not** the GIF or PNG files. Explain why the SVG file size increases. 2
 - (b) The finished graphic will be displayed on a variety of screen sizes. Explain why SVG might be the **best** format to choose in this situation. 2
 - (c) Part of the code for the smallest circle is changed from **rgb(0,78,0)** to **rgb(0,16,0)**. Describe the effect of this change on the circle. 2
 - (d) Dithering can be used with the GIF file format but is unnecessary with PNG.
 - (i) Explain the term *dithering*. 1
 - (ii) Explain why dithering is not required for the PNG file format. 2
 - (e) The graphics software used by the designer includes *anti-aliasing*.
 - (i) State the purpose of anti-aliasing. 1
 - (ii) Describe a situation when anti-aliasing might have to be used. 1
- (50)**

[END OF SECTION III—PART C]

[END OF QUESTION PAPER]

ACKNOWLEDGEMENTS

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