7 A high definition video and a large text file are to be sent as email attachments. Both files are compressed before sending. Each file is compressed using a different type of data compression algorithm.

Explain, with reasons, which type of data compression algorithm should be chosen for each file.

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.....[4]

8 A register in a computer contains binary digits.

0	0	1	1	0	1	1	1

(a) The contents of the register could represent a binary integer.
Convert the binary integer to denary and hexadecimal.

Denary .....

Hexadecimal .....

[2]

(b) The contents of the register could represent the ASCII value for the single denary digit '7'.
Write down the ASCII value for '9' in binary, denary and hexadecimal.

Binary .....

Denary .....

Hexadecimal .....

[3]

(c) Write in Register X the binary number you would use with AND gates to convert the ASCII value of '7' to its binary integer value.

0	0	1	1	0	1	1	1	**ASCII**
								Register X

[1]

12 **(a)** Identify **three** uses for hexadecimal and for each one give an example of hexadecimal that matches the use.

Use 1 .....

.....

Example .....

Use 2 .....

.....

Example .....

Use 3 .....

.....

Example .....

[6]

(b) Explain why hexadecimal is used to represent binary numbers.

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.....[2]

9 Draw a line to connect each question to the correct answer.

Question	Answer
What is the denary (base 10) equivalent to the hexadecimal digit **E**?	**8**
If 1 GB = 2^X then what is the value of X?	**12**
How many bits are there in one byte?	**14**
If the broadband data download rate is 40 megabits per second, how many seconds will it take to download a 60 MB file?	**19**
What is the denary (base 10) value of the binary number 0 0 1 0 0 1 0 0 ?	**30**
What hexadecimal value is obtained when the two hexadecimal digits **C** and **D** are added together?	**36**

[5]

10 Letters from the alphabet are represented in a computer by the following denary (base 10) values:

A = 97
G = 103
I = 105
L = 108
N = 110

The word "**A L I G N**" is stored as: 97 108 105 103 110

(a) Convert each of the five values to binary. The first one has been done for you.

Letter	Denary value							
A (97):	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**
L (108):								
I (105):								
G (103):								
N (110):								

[2]

(b) An encryption system works by shifting the binary value for a letter one place to the left. "A" then becomes:

1	**1**	**0**	**0**	**0**	**0**	**1**	**0**

This binary value is then converted to hexadecimal; the hexadecimal value for "A" will be:

C 2

For the two letters "L" and "G", shift the binary values one place to the left and convert these values into hexadecimal:

								hexadecimal
L:								.....
G:								.....

[4]

7 Each seat on a flight is uniquely identified on an LCD above the seat. For example, seat 035C is shown as:

The first three characters are digits that represent the row.
The fourth character is the seat position in that row. This is a single letter, A to F, that is stored as a hexadecimal value.

Each of the four display characters can be stored in a 4-bit register. For example, 0 and C would be represented as:

	8	4	2	1
0:	**0**	**0**	**0**	**0**
C:	**1**	**1**	**0**	**0**

(a) Show how the 4-bit registers would store the remaining two characters, 3 and 5.

3 ☐☐☐☐

5 ☐☐☐☐

[2]

(b) Identify which seat is stored in the following 4-bit registers.

0	**0**	**0**	**1**	→ .....
1	**0**	**0**	**1**	→ .....
0	**1**	**0**	**0**	→ .....
1	**1**	**1**	**0**	→ .....

[2]

3 **(a)** Convert the following hexadecimal number into 12-bit binary:

4 A F

[3]

(b) The 2016 Olympic Games will be held in Rio de Janeiro. A timer that counts down to the opening of the Games is shown on a microprocessor-controlled display.

The number of hours, minutes and seconds until the Games open are held in three 8-bit registers.

The present register values are:

0	1	1	0	1	0	0	1	105 hours
0	0	1	0	0	0	0	0	32 minutes
0	0	0	1	0	1	0	0	20 seconds

The timer will count **down** in seconds.

(i) Show the values in each 8-bit register **30 seconds** after the time shown above:

								hours
								minutes
								seconds

[3]

(ii) Write the hexadecimal value of the **minutes** register from **part (b)(i)**.

.....[1]

4 Nigel wants to send a large text file electronically to Mashuda.

(a) Describe how the size of the text file can be reduced.

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.....[3]

(b) This file will be transmitted to Mashuda as an email attachment. Mashuda then stores it on her computer.

Explain how checksums can be used to verify that the file has not been corrupted during transmission or data storage.

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.....[4]

1 The memory of a computer contains data and instructions in binary.

The following instruction is stored in a location of the memory.

0	0	1	0	1	0	0	1	1	1	1	1	1	1	0	0

(a) Convert the instruction into hexadecimal.

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..... [2]

(b) Explain why a programmer might prefer to read the instruction in hexadecimal rather than in binary.

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..... [2]

(c) Give **two** other uses of hexadecimal.

Use 1 .....

.....

Use 2 .....

.....

[2]

3 Steffi has a number of files of different sizes that contain her work.

Tick (✓) to show whether each statement is **true** or **false**.

Statement	true (✓)	false (✓)
47KB is larger than 10MB.		
250bytes is smaller than 0.5MB.		
50GB is larger than 100MB.		
1TB is smaller than 4GB.		

[4]

5 **(a)** The denary number 57 is to be stored in two different computer registers.

Convert 57 from denary to binary and show your working.

.....

.....

.....

.....[2]

(b) Show the binary number from **part (a)** as it would be stored in the following registers.


Register 1


Register 2

[2]

(c) A binary number stored in a register can have many different uses, for example an address in main memory.

Give **two** other uses for a binary number stored in a register.

Use 1 .....

Use 2 .....

[2]

(d) A register in a computer contains binary digits.

0	**0**	**1**	**1**	**1**	**0**	**1**	**0**

The contents of the register represent a binary integer.

Convert the binary integer to hexadecimal.

.....

.....[1]

2 Data files are stored in different file formats.

Complete the table by providing a suitable file format for each file type. The first one has been done for you.

File type	File format
Pictures	.JPEG
Text	
Sound	
Video	

[3]

1 A robot arm in a factory is programmed to move products.

The binary instructions to operate the robot arm are:

Operation	Binary Instruction
UP	1 1 1 1
DOWN	0 0 0 1
LEFT	1 0 0 1
RIGHT	0 1 1 0
OPEN	1 1 0 0
CLOSE	0 0 1 1

The instructions are entered as hexadecimal values.

An operator enters the values:

9 1 C 3 F

Convert the values and write down the operation (e.g. RIGHT) carried out by the robot arm.

9 .....

1 .....

C .....

3 .....

F .....

[5]

3 **(a)** Explain the differences between the binary number system and the denary number system.

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.....[4]

(b) Explain the process of converting the binary number 1010 into a denary number.

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.....[5]

2 **(a)** Convert the hexadecimal number **B5** into binary:

.....

Convert the binary number **1 1 1 1 0 1 1 0** into hexadecimal:

.....

[2]

(b) Give **two** examples where hexadecimal numbers are used in computer science.

1 .....

.....

2 .....

.....

[2]

(c) State **two** benefits of using hexadecimal numbers in computer science.

1 .....

.....

2 .....

.....

[2]

7 **(a)** Describe what is meant by lossy and lossless compression when applied to files.

Lossy .....

.....

.....

Lossless .....

.....

.....
[2]

(b) Name and describe **one** type of file that uses lossy compression.

Name .....

Description .....

.....

.....
[2]

(c) A company advertises its backup memory device as having 500 GB of storage.
A customer wishes to know how many 8 MB files could be stored on the device.

The company claimed that up to 62 500 files (assuming each file is 8 MB) could be stored.

The customer calculated that 64 000 files could be stored.

Explain the difference between these two storage values. Show any calculations you use in your explanation.

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.....

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..... [3]

9 **(a)** Nicolae made the following statement:
"data input is validated by typing it in twice"

State why this statement is incorrect.

.....

..... [1]

(b) Nicolae needs to send 30 photos to a friend and he chooses to send all 30 together as a single email attachment. Each photo is 1.8 MB in size, but the maximum possible attachment size is only 20 MB.

State how Nicolae can solve this problem.

.....

..... [1]

10 Characters can be represented in a computer by a numerical code.

The following list shows 16 characters with their numerical codes in denary:

a = 97	e = 101	k = 107	t = 116
b = 98	g = 103	m = 109	u = 117
c = 99	h = 104	o = 111	w = 119
d = 100	i = 105	r = 114	

. = 46 (code for the full stop)

Web addresses can be written using hexadecimal rather than denary. Hexadecimal codes are preceded by a % sign. For example, the word "**c a g e**" is written as:

either	99	97	103	101	(in denary)
or	%63	%61	%67	%65	(in hexadecimal)

(a) Complete the conversion of the following web address into hexadecimal:

w	**w**	**w**	**.**	**c**	**i**	**e**	**.**	**o**	**r**	**g**	**.**	**u**	**k**
%77	%77	%77											

[3]

(b) Complete the web address from the given hexadecimal codes:

%77	**%77**	**%77**	**%2E**	**%72**	**%6F**	**%63**	**%6B**	**%69**	**%63**	**%74**	**%2E**	**%63**	**%6F**	**%6D**
W	W	W												

[3]

2 Seven computer terms and seven descriptions are shown below.

Draw a line to link each computer term to its most appropriate description.

Computer term	Description
Interface	Reduction of file size by permanently removing some redundant information from the file
Interrupt	File compression format designed to make photo files smaller in size for storage and for transmission
JPEG	File compression system for music which does not noticeably affect the quality of the sound
Lossless compression	Hardware component that allows the user to communicate with a computer or operating system
Lossy compression	The file is reduced in size for transmission and storage; it is then put back together again later producing a file identical to the original
MIDI	Signal sent to a processor which may cause a break in execution of the current routine, according to priorities
MP3 format	Standard adopted by the electronic music industry for controlling devices such as synthesisers and sound cards

[6]

4 (a) (i) Convert the following **two** hexadecimal numbers into binary:

F A 7
D 3 E

F A 7 | | | | | | | | | | | |

D 3 E | | | | | | | | | | | |

[4]

(ii) Now perform the AND (logic) operation on each corresponding pair of binary bits in the two numbers from **part (i)**.

| | | | | | | | | | | | |

[2]

(iii) Convert your answer in **part (ii)** into hexadecimal.

.....

.....

[2]

(b) **(i)** The following code shows HTML 'tag' pairs on either side of the text stating the colour that each creates.

```
<font color " # F F 0 0 0 0 " > RED </font>
<font color " # 0 0 F F 0 0 " > GREEN </font>
<font color " # 0 0 0 0 F F " > BLUE </font>

<font color " #      X      " > YELLOW </font>
<font color " #      Y      " > MAGENTA </font>
<font color " #      Z      " > CYAN </font>
```

Yellow is a combination of red and green, magenta a combination of red and blue and cyan a combination of green and blue.

State what 6-digit hexadecimal values should replace X, Y and Z in the above code.

X .....

Y .....

Z .....

[3]

(ii) Describe how other colours, such as a darker shade of blue, are created.

.....

.....

.....

[2]

(c) 1A – 16 – C5 – 22 – FF – FF is an example of a MAC address.

(i) Identify what the first six and last six hexadecimal digits represent.

First six digits .....

.....

.....

Last six digits .....

.....

.....

[2]

9 MP3 file compression reduces the size of a music file by 90%.

(a) A music track is 80 MB in size.

Calculate the file size after compression.

.....

How many MP3 files of the size calculated above could be stored on an 800 MB CD?

.....

[2]

(b) **(i)** Explain how MP3 files retain most of the original music quality.

.....

.....

.....

.....

..... [2]

(ii) State the type of file compression used in MP3 files.

..... [1]

(iii) Name another file compression format.

..... [1]

10 **(a)** A manufacturer of aeroplane engines assigns a denary identification number (ID) to each engine.

One engine has the ID: 0431

(i) Convert this denary number to a 12-bit binary format.

[2]

(ii) Show how this number would be represented in hexadecimal.

.....

.....

[3]

(b) The current status of the engine is sent to a computer in the aeroplane.

Each piece of data collected is 8 bytes in size. Data collection occurs every 30 seconds.

Calculate the number of kilobytes that would be needed to store the data collected during a 10-hour flight. Show your working.

.....

.....

.....

.....

..... kilobytes

[3]

5 A computer uses an 8-bit register.

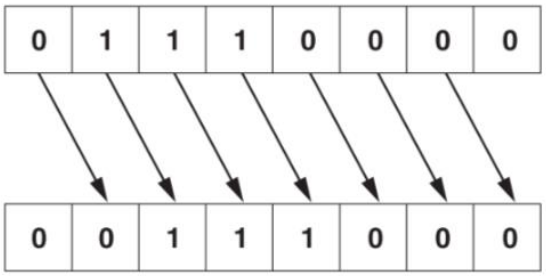
The 8-bit register contains binary integers.

(a) Write the denary (base 10) value represented by:

128	64	32	16	8	4	2	1
0	1	1	1	0	0	0	0

.....[1]

(b) All the bits in the register are shifted **one** place to the **right** as shown below.



Write the denary number that is represented after this shift.

.....[1]

(c) State the effect the shift to the right had on the original denary number from **part (a)**.

.....[1]

(d) The original number in **part (a)** is shifted **three** places to the **right**.

(i) Show the new binary number:

[1]

(ii) Write the equivalent denary number.

.....[1]

8 Identify whether the **four** statements about file compression are correct by writing TRUE or FALSE in the following table.

Statement	TRUE or FALSE
MIDI files store the actual music notes in a compressed format	
JPEG files are examples of lossless file compression	
MP3 files are, on average, 90% smaller than the music files stored on a CD	
MP4 files are examples of lossy file compression	

[4]