OCR GCSE (J277)

Module C: Data representation

Workbooklet · 10 parts · 202 marks

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MODULE C DATA REPRESENTATION · C1

Why computers use binary

Original practice questions · 20 marks · ~25 minutes · OCR J277 spec 1.2.3

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. No calculator. The marks for each part are shown in brackets [ ]. The total for this worksheet is **20 marks**.

1

Total: 3 marks

(a) State the **two** digits used in binary. **[1]**

(b) State the name given to a single binary digit. **[1]**

(c) Tick (✓) **one** box to show what a processor is built from. **[1]**

Component	Tick (✓) one
Billions of tiny switches (transistors)	
A small number of large dials	
Billions of tiny light bulbs	
Magnetic tape	

2

Total: 4 marks

(a) Tick (✓) **one** box in each row to show whether each statement is true or false. **[4]**

Statement	True	False
Each switch in a processor can be in one of three states		
The instructions in a program are stored in binary		
Images are stored as pictures, so they do not need converting to binary		
A switch that is on can be represented by 1		

3 **Total: 4 marks**

A delivery firm fits a smart doorbell at each of its depots. The doorbell has a camera, a microphone and a small screen that shows text messages to drivers.

(a) Identify **two** different types of data the doorbell must convert into binary before it can process them. **[2]**

1

2

(b) A driver speaks into the microphone. Describe what must happen to the sound before the doorbell's processor can process it, and why. **[2]**

4 **Total: 4 marks**

Each extra switch doubles the number of different on/off patterns that a group of switches can make.

(a) Complete the table to show how many different patterns each group of switches can make. **[3]**

Number of switches	Number of different patterns
1	2
2	.....
3	.....
8	.....

(b) State the name given to a group of 8 bits. **[1]**

5 **Total: 2 marks**

(a) Explain why a computer must convert data into binary format before it can process it. **[2]**

6 **Total: 3 marks**

An IT technician writes this in a training guide: *"Computers use binary because binary is the only thing they understand."*

(a) Explain why this statement does not fully explain why computers use binary, and give a better explanation. **[3]**

Total for this worksheet: 20 marks

MODULE C DATA REPRESENTATION · C2

Converting denary and binary

Original practice questions · 20 marks · ~25 minutes · OCR J277 spec 1.2.4

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. No calculator. All binary numbers are positive whole numbers of up to 8 bits. The marks for each part are shown in brackets [ ]. The total for this worksheet is **20 marks**.

1

Total: 2 marks

(a) State the place value of the most significant bit (MSB) in an 8-bit binary number. **[1]**

(b) State the largest denary number that can be stored in 8 bits. **[1]**

2

Total: 3 marks

(a) Convert the binary number **00101101** into denary. **[1]**

(b) Convert the binary number **11010010** into denary. **[1]**

(c) Convert the 4-bit binary number **1011** into denary. **[1]**

3

Total: 5 marks

(a) Convert the denary number **77** into an 8-bit binary number. Show your working. **[2]**

Answer: .....

(b) Convert the denary number **200** into an 8-bit binary number. Show your working. **[2]**

Answer: .....

(c) Convert the denary number **6** into an 8-bit binary number. **[1]**

Answer: .....

4

Total: 4 marks

A greenhouse controller stores settings, such as fan speed and window opening, as 8-bit binary numbers.

(a) Complete the table by filling in each empty box. **[4]**

Setting	Denary	8-bit binary
Fan speed		01100100
Window opening	170	
Light level		11111110
Water timer	33	

5

Total: 3 marks

A technician converts the denary number 156 into 8-bit binary and writes **00111001**.

(a) Explain the mistake the technician has made and give the correct 8-bit binary number for 156. **[3]**

Correct binary: .....

6

Total: 3 marks

(a) A sensor stores each reading using 5 bits. State the largest denary number the sensor can store. **[1]**

(b) Explain why the denary number 300 cannot be stored as an 8-bit binary number. **[2]**

Total for this worksheet: 20 marks

MODULE C DATA REPRESENTATION · C3

Hexadecimal

Original practice questions · 21 marks · ~25 minutes · OCR J277 spec 1.2.4

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. No calculator. Hexadecimal numbers on this worksheet have up to **2 digits** (00 to FF). The marks for each part are shown in brackets [ ]. The total for this worksheet is **21 marks**.

1

Total: 4 marks

(a) State how many different digits the hexadecimal number system uses. **[1]**

(b) State the denary value of the hexadecimal digit C. **[1]**

(c) State the largest 2-digit hexadecimal number **and** its denary value. **[2]**

Hexadecimal: .....

Denary: .....

2

Total: 4 marks

A theatre uses a lighting controller. Each light has a brightness level from 0 to 255, which the controller's screen shows as a 2-digit hexadecimal number.

(a) Convert the denary brightness 75 into hexadecimal. **[1]**

Answer: .....

(b) Convert the denary brightness 160 into hexadecimal. Show your working. **[2]**

Answer: .....

(c) Convert the denary brightness 13 into 2-digit hexadecimal. **[1]**

Answer: .....

3 **Total: 4 marks**

The lighting technician reads these hexadecimal brightness levels from the controller.

(a) Convert the hexadecimal number 2E into denary. **[1]**

Answer: .....

(b) Convert the hexadecimal number B7 into denary. Show your working. **[2]**

Answer: .....

(c) Convert the hexadecimal number F0 into denary. **[1]**

Answer: .....

4 **Total: 4 marks**

(a) Complete the table by writing the missing value in each row. **[4]**

Denary	Hexadecimal
100	
30	
	9C
	50

5 **Total: 3 marks**

(a) Describe how the hexadecimal number 3D is converted into denary. Give the denary answer. **[3]**

6 **Total: 2 marks**

The technician sets up two spotlights for a new scene.

(a) The first spotlight is set to hexadecimal C4. Convert C4 into denary. **[1]**

Answer: .....

(b) The second spotlight needs a brightness of denary 58. Convert 58 into hexadecimal. **[1]**

Answer: .....

Total for this worksheet: 21 marks

MODULE C DATA REPRESENTATION · C4

Converting binary and hexadecimal

Original practice questions · 20 marks · ~25 minutes · OCR J277 spec 1.2.4

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. No calculator. All binary numbers are 8 bits and all hexadecimal numbers are 2 digits. The marks for each part are shown in brackets [ ]. The total for this worksheet is **20 marks**.

1

Total: 5 marks

(a) State how many binary digits (bits) are represented by **one** hexadecimal digit. **[1]**

(b) Convert the binary number 1001 1101 into hexadecimal. Show your working. **[2]**

Answer: .....

(c) Convert the binary number 0111 0000 into hexadecimal. **[2]**

Answer: .....

2

Total: 4 marks

(a) Convert the hexadecimal number 4C into 8-bit binary. Show your working. **[2]**

Answer: .....

(b) Convert the hexadecimal number F3 into 8-bit binary. **[2]**

Answer: .....

3 Total: 4 marks

(a) Complete the table by writing the missing 8-bit binary or 2-digit hexadecimal value in each gap. **[4]**

8-bit binary	Hexadecimal
0010 1011	
	E8
1111 1111	
	06

4 Total: 2 marks

A heating engineer reads a fault code from a boiler control board. The board shows the code as the binary number 1010 0001. The engineer converts it and writes the hexadecimal code as **101**.

(a) Identify the mistake the engineer has made. **[1]**

(b) Write the correct hexadecimal code. **[1]**

Answer: .....

5 Total: 3 marks

(a) Describe how to convert an 8-bit binary number into hexadecimal. Use your own example in your answer. **[3]**

6 **Total: 2 marks**

(a) Tick (✓) **one** box to show the hexadecimal value of the binary number 1100 0111. **[1]**

Hexadecimal	Tick (✓) one
7C	
C7	
127	
CF	

(b) State the largest hexadecimal value that can be stored in 8 bits. **[1]**

Total for this worksheet: 20 marks

MODULE C DATA REPRESENTATION · C5

Binary addition and overflow

Original practice questions · 20 marks · ~25 minutes · OCR J277 spec 1.2.4

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. No calculator. All numbers are unsigned (positive) 8-bit binary. When you add, show your carries: converting to denary and back does not count as binary working. The marks for each part are shown in brackets [ ]. The total for this worksheet is **20 marks**.

1

Total: 2 marks

(a) State the result of adding the binary digits 1 + 1, written as a 2-bit binary number. **[1]**

(b) State the largest denary number that can be stored in 8 bits. **[1]**

2

Total: 2 marks

(a) Add the binary numbers 00110101 and 01001110. Show your working. Use the grid. The dashed column on the left is for any carry out of the 128 column. **[2]**

	128	**64**	**32**	**16**	**8**	**4**	**2**	**1**	
	0	0	1	1	0	1	0	1	
	0	1	0	0	1	1	1	0	+
Answer									
Carries									

3 **Total: 7 marks**

A ticket gate in a railway station counts people in an 8-bit register. Every hour the gate adds the new count to a running total.

(a) Add the binary numbers 10010110 and 00111011. Show your working. **[2]**

128 64 32 16 8 4 2 1

1 0 0 1 0 1 1 0

0 0 1 1 1 0 1 1 +

Answer

Carries

(b) Later the gate adds the binary numbers 11001100 and 01010101. Add them. Show your working. **[2]**

128 64 32 16 8 4 2 1

1 1 0 0 1 1 0 0

0 1 0 1 0 1 0 1 +

Answer

Carries

(c) State the type of error that happens in the addition in part (b). **[1]**

(d) Explain why this error happens in part (b). **[2]**

4 **Total: 4 marks**

(a) Each row shows an addition of two 8-bit binary numbers. Tick (✓) **one** box in each row to show whether the addition causes an overflow error in 8 bits. **[4]**

Addition	Overflow error	No overflow error
01111111 + 00000001		
10000000 + 10000000		
01010101 + 00101010		
11110000 + 00010001		

5 **Total: 2 marks**

(a) A warehouse scanner adds two 8-bit numbers. The answer is 11110000, but one bit of each number has been smudged (shown as ?). **[2]**
Write the missing bit of each number so that the addition is correct.

128 64 32 16 8 4 2 1

0 1 0 1 ? 0 1 0

1 ? 0 1 0 1 1 0 +

1 1 1 1 0 0 0 0 Answer

First number missing bit: ..... Second number missing bit: .....

6 **Total: 3 marks**

A fitness tracker stores the number of floors climbed in a day in an 8-bit register.

(a) A user climbs 140 floors in one day, then the tracker adds another 120. Describe what goes wrong with the stored total and what effect this could have for the user. **[3]**

Total for this worksheet: 20 marks

MODULE C DATA REPRESENTATION · C6

Binary shifts

Original practice questions · 19 marks · ~25 minutes · OCR J277 spec 1.2.4

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. No calculator. All binary numbers are 8 bits. The marks for each part are shown in brackets [ ]. The total for this worksheet is **19 marks**.

1

Total: 3 marks

(a) State the effect on a number of a binary shift of **one** place to the **left**. **[1]**

(b) State the effect on a number of a binary shift of **two** places to the **right**. **[1]**

(c) State the binary digit that fills the gaps made by a binary shift. **[1]**

2

Total: 3 marks

(a) Give the 8-bit result of carrying out a binary shift of **two** places to the **left** on the binary number **00011010**. **[1]**

	128	64	32	16	8	4	2	1
Result								

(b) Give the 8-bit result of carrying out a binary shift of **three** places to the **right** on the binary number **01110000**. **[1]**

	128	64	32	16	8	4	2	1
Result								

(c) Convert your answer to part (b) into denary. **[1]**

Answer (denary): .....

3 **Total: 4 marks**

An adult-education centre's heating controller stores the room temperature reading as an 8-bit binary number. The reading is 01011001.

(a) Give the 8-bit result of a binary shift of **one** place to the **right** on 01011001. **[1]**

Answer (binary): .....

(b) Convert your result from part (a) into denary. **[1]**

Answer (denary): .....

(c) 01011001 is 89 in denary, and 89 ÷ 2 = 44.5. Explain why the shifted result is **not** 44.5. **[2]**

4 **Total: 4 marks**

(a) The number 00000111 is shifted to give 00111000. Identify the binary shift that was applied. **[2]**

Direction: .....

Number of places: .....

(b) The number 10100000 is shifted to give 00001010. Identify the binary shift that was applied. **[2]**

Direction: .....

Number of places: .....

5 **Total: 2 marks**

(a) A program needs to multiply a binary number by 16. Describe the binary shift that would do this. **[2]**

6 **Total: 1 mark**

(a) Tick (✓) **one** box to show the result of a binary shift of **two** places to the **right** on 00110100. **[1]**

Result	Tick (✓) one
11010000	
00001101	
00011010	
00001110	

7 **Total: 2 marks**

(a) Explain why a binary shift of one place to the left doubles a number (as long as no 1s are shifted off the end). **[2]**

Total for this worksheet: 19 marks

MODULE C DATA REPRESENTATION · C8

Character sets: ASCII and Unicode

Original practice questions · 20 marks · ~25 minutes · OCR J277 spec 1.2.4

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. No calculator. You do not need to remember any character codes: use the codes given. ASCII codes are written as 8 bits. The marks for each part are shown in brackets [ ]. The total for this worksheet is **20 marks**.

1

Total: 2 marks

(a) State what is meant by the term **character set**. **[1]**

(b) State the number of bits used to represent each character in ASCII. **[1]**

Answer: .....

2

Total: 3 marks

A warehouse label printer uses ASCII. Part of its character set is shown below.

Character	ASCII code (denary)	ASCII code (binary)
C	67	01000011
D	68	01000100
E		
F		

(a) Identify the denary ASCII code for **F**. **[1]**

Answer: .....

(b) Identify the 8-bit binary ASCII code for **E**. **[1]**

Answer: .....

(c) The printer also prints a lower case **f**. Explain why its code is **not** the same as the code for **F**. **[1]**

3 **Total: 3 marks**

The ASCII code for **A** is 65, which is 01000001 in 8-bit binary.

(a) Write the word **BAG** in 8-bit binary ASCII. One character per row. **[3]**

Character	8-bit binary ASCII code
B	
A	
G	

4 **Total: 3 marks**

A taxi firm's booking system stores a three-letter area name in ASCII. The ASCII code for lower case **a** is 97. The stored codes are:
01100011 01100001 01100010

(a) Identify the three characters that are stored. Show your working. **[3]**

Characters: .....

5 **Total: 4 marks**

(a) State the number of different characters that can be represented using 8 bits per character. **[1]**

Answer: .....

(b) A simple display on a machine uses a character set with 4 bits per character. State the maximum number of characters it can represent. **[1]**

Answer: .....

(c) Explain the relationship between the number of bits per character and the number of characters a character set can represent. **[2]**

6 **Total: 5 marks**

A travel company sends text messages to customers around the world. Messages are written in many languages, including Chinese and Arabic, and some include emojis.

(a) Identify **one** benefit of using Unicode instead of ASCII. **[1]**

(b) Identify **one** drawback of using Unicode instead of ASCII. **[1]**

(c) Explain why the company should use Unicode rather than ASCII for its messages. **[3]**

Total for this worksheet: 20 marks

MODULE C DATA REPRESENTATION · C9

Representing images

Original practice questions · 21 marks · ~25 minutes · OCR J277 spec 1.2.4

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. No calculator. The marks for each part are shown in brackets [ ]. The total for this worksheet is **21 marks**.

1

Total: 3 marks

(a) Define the term **pixel**. **[1]**

(b) State what is meant by the **colour depth** of an image. **[1]**

(c) State what is meant by the **resolution** of an image. **[1]**

2

Total: 5 marks

A sign-making company stores its designs as bitmap image files.

(a) State what is meant by **metadata**. **[1]**

(b) Identify **two** items of metadata that could be stored in the file of a bitmap image. **[2]**

1

2

(c) Explain why the metadata is needed when the image is displayed. **[2]**

3 **Total: 4 marks**

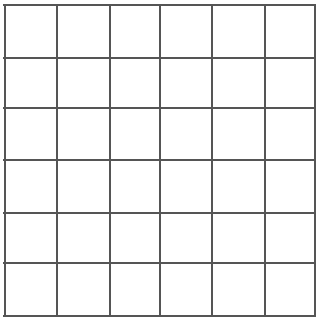
The company also makes small black-and-white icons for its door signs.

(a) An icon file stores this metadata: width 6 pixels, height 6 pixels, colour depth 1 bit. A 1 is a black pixel and a 0 is a white pixel. The pixels are stored row by row, starting at the top left. **[2]**

The pixel data is:

`001100 011110 111111 010010 010010 011110`

Shade the grid to show the image.



(b) The company wants the icon to use 4 different colours. State the smallest colour depth it needs. **[1]**

(c) State how many different colours can be represented with a colour depth of 3 bits. **[1]**

4 **Total: 1 mark**

(a) A logo uses 50 different colours. State the **minimum** number of bits per pixel needed to store the logo. **[1]**

5 **Total: 4 marks**

(a) Tick (✓) **one** box in each row to show whether each statement is true or false. **[4]**

Statement	True	False
Increasing the resolution of an image increases its file size		
A colour depth of 8 bits allows 8 different colours		
Increasing the colour depth adds more pixels to the image		
Reducing the colour depth makes the image file smaller		

6 **Total: 4 marks**

A photographer uploads photographs to a gallery website. The website asks for smaller image files, so the photographer considers reducing the resolution and the colour depth of each photograph.

(a) Explain how reducing the **resolution** and reducing the **colour depth** would affect the photographs. Refer to the quality of the images **and** their file size. **[4]**

Total for this worksheet: 21 marks

MODULE C DATA REPRESENTATION · C10

Representing sound

Original practice questions · 21 marks · ~25 minutes · OCR J277 spec 1.2.4

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. No calculator. The marks for each part are shown in brackets [ ]. The total for this worksheet is **21 marks**.

1

Total: 3 marks

(a) State what is meant by the **sample rate** of a sound file. **[1]**

(b) State the unit used to measure sample rate. **[1]**

(c) State what is meant by the **bit depth** of a sound file. **[1]**

2

Total: 4 marks

(a) Complete the description of how sound is sampled and stored. Use words from the box. Not all words are used. **[4]**

amplitude	analogue	binary	frequency
pixels	random	regular	digital

Sound in the real world is an ..... wave. To store it, the height of the wave, called its ....., is measured. These measurements are taken at ..... intervals. Each measurement is a sample, and it is stored in ..... .

3

Total: 2 marks

(a) A sound file has a bit depth of 3 bits. State how many different values each sample can take. **[1]**

(b) The bit depth is increased to 4 bits. State how many different values each sample can now take. **[1]**

4 Total: 4 marks

(a) A recording is changed in four different ways. For each change, tick (✓) **one** box for playback quality **and one** box for file size. Everything else stays the same. **[4]**

Change	Quality better	Quality worse	Quality same	File larger	File smaller
Sample rate increased					
Bit depth decreased					
Duration increased					
Sample rate decreased					

5 Total: 4 marks

A charity records phone messages for its helpline using a sample rate of 8,000 Hz and a bit depth of 8 bits.

(a) Explain why the 8,000 Hz recording sounds less like the original voice than a recording made at 44,100 Hz with the same bit depth. **[2]**

(b) The charity considers increasing the bit depth from 8 bits to 16 bits. Explain **one** disadvantage of doing this. **[2]**

6 **Total: 4 marks**

A wildlife ranger's recorder makes two recordings of birdsong with the same sample rate and bit depth. One lasts 2 minutes and the other lasts 4 minutes.

(a) State the effect on the file size of the 4-minute recording compared with the 2-minute recording. **[1]**

(b) Explain why the 4-minute recording does **not** have better playback quality than the 2-minute recording. **[2]**

(c) The ranger wants the 4-minute recording to have a smaller file size. State **one** setting that could be changed, and how, to do this. **[1]**

Total for this worksheet: 21 marks

MODULE C DATA REPRESENTATION · C11

Compression, lossy and lossless

Original practice questions · 20 marks · ~25 minutes · OCR J277 spec 1.2.5

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. No calculator. The marks for each part are shown in brackets [ ]. The total for this worksheet is **20 marks**.

1

Total: 2 marks

A design agency sends large image and document files to its clients every day.

(a) Give **two** benefits to the agency of compressing these files. **[2]**

1

2

2

Total: 4 marks

(a) Tick (✓) **one** box in each row to show whether each statement describes lossy compression or lossless compression. **[4]**

Statement	Lossy	Lossless
Data is permanently removed from the file		
The original file can be restored exactly		
The quality of the file may be reduced		
Usually gives the larger compressed file of the two types		

3 **Total: 6 marks**

A housing association compresses files before uploading them to its website.

(a) The association uploads a tenancy agreement stored as a text file. Identify the most suitable type of compression for this file. Justify your choice. **[3]**

Type: .....

(b) The association also uploads photographs of its buildings for visitors to view. Identify the most suitable type of compression for the photographs. Justify your choice. **[3]**

Type: .....

4 **Total: 2 marks**

(a) Give **one** disadvantage of lossy compression. **[1]**

(b) Give **one** disadvantage of lossless compression. **[1]**

5 **Total: 2 marks**

A software company compresses the program file for its new app before people download it.

(a) Explain why the company must **not** use lossy compression for the program file. **[2]**

6 **Total: 4 marks**

A music streaming service sends songs to listeners' phones over the internet. It is deciding whether to compress its song files with lossy or lossless compression.

(a) Explain the advantages and disadvantages of using **lossy** compression for the song files. **[4]**

Total for this worksheet: 20 marks