OCR GCSE (J277)

Module C: Data representation

Workbooklet mark scheme · 10 parts · 202 marks

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	Total	**202**

MODULE C DATA REPRESENTATION · C1

Why computers use binary: mark scheme

20 marks · OCR J277 spec 1.2.3

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative answers. Words in (brackets) are not needed for the mark. NE = not enough for the mark.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) J277 1.2.3	0 and 1	**1**	Both needed, either order. "On and off" alone = NE.
1(b) J277 1.2.3	bit	**1**	Do not accept byte / nibble.
1(c) J277 1.2.3	Billions of tiny switches (transistors)	**1**	More than one tick = 0.
2(a) J277 1.2.3	Three states: False Program instructions in binary: True Images not converted: False On = 1: True	**4**	1 mark per correct row. More than one tick in a row = 0 for that row. Row 1: switches have only two states, on and off. Row 3: all data, including images, is stored in binary.
3(a) J277 1.2.3	Images / video (from the camera) Sound / audio (from the microphone) Text / characters (messages on the screen)	**2**	Any two, 1 mark each. Accept numbers / program instructions. Two answers of the same type (e.g. "photos" and "video") = 1.
3(b) J277 1.2.3	The sound must be converted into binary / 1s and 0s / bits ... because the processor is made of switches that can only be on or off / have two states ... so it can only process data in binary	**2**	Max 2. "It is recorded / saved" alone = NE. Sampling detail is not needed (C10), but accept a correct description of measuring the sound and storing the values in binary.
4(a) J277 1.2.3	2 switches: 4 3 switches: 8 8 switches: 256	**3**	1 mark per row. Working: doubling 2 → 4 → 8 → 16 → 32 → 64 → 128 → 256 (2^8 = 256). Do not accept 255 for 8 switches (that is the largest number, not the number of patterns).
4(b) J277 1.2.3	byte	**1**	Do not accept nibble / bit.

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) J277 1.2.3	Computers / processors are made of (billions of) switches / transistors / logic gates ... that have only two states / can only be on or off The two states can be represented by 1 and 0 / binary (So) all data must be in binary to be processed / stored	**2**	1 mark per bullet, max 2. "Computers only understand binary" alone = NE.
6(a) J277 1.2.3	The statement gives no reason / does not say why / is too vague A processor is made of (billions of) switches / transistors Each switch has only two states / is on or off On and off can be represented by 1 and 0 / binary digits So all data (text, images, sound, instructions) must be converted into binary to be processed	**3**	1 mark per bullet, max 3. Repeating "computers only understand binary" earns nothing.

Total: 20 marks

MODULE C DATA REPRESENTATION · C2

Converting denary and binary: mark scheme

20 marks · OCR J277 spec 1.2.4

How to use. One mark per bullet up to the maximum shown. **/** separates alternatives. Words in (brackets) are not needed for the mark. Place values are 128 64 32 16 8 4 2 1, MSB on the left. A binary answer with the bits in the wrong order (written backwards) is never credited. Where a question says "Show your working", a correct final answer with no working still gets full marks; working marks are there to reward a sound method with a slip. For 8-bit answers, accept the value without leading zeros only where stated.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) J277 1.2.4	128	**1**	Accept 2^7.
1(b) J277 1.2.4	255	**1**	11111111 = 128+64+32+16+8+4+2+1 = 255. Do not accept 256.
2(a) J277 1.2.4	45	**1**	32 + 8 + 4 + 1 = 45.
2(b) J277 1.2.4	210	**1**	128 + 64 + 16 + 2 = 210.
2(c) J277 1.2.4	11	**1**	Headings 8 4 2 1: 8 + 2 + 1 = 11. Do not accept 13 (read backwards).
3(a) J277 1.2.4	Working: e.g. 77 − 64 = 13, 13 − 8 = 5, 5 − 4 = 1, 1 − 1 = 0 / 64 + 8 + 4 + 1 / headings with 1s under 64, 8, 4, 1 01001101	**2**	1 mark working, 1 mark answer. Correct answer with no working = 2. Accept repeated division by 2 with remainders read in the correct order. Answer must be 8 bits; 1001101 = working mark only. 10110010 (reversed) = 0 for the answer mark.
3(b) J277 1.2.4	Working: e.g. 200 − 128 = 72, 72 − 64 = 8, 8 − 8 = 0 / 128 + 64 + 8 11001000	**2**	1 mark working, 1 mark answer. Correct answer with no working = 2. 00010011 (reversed) = 0 for the answer mark.
3(c) J277 1.2.4	00000110	**1**	4 + 2 = 6. Must be 8 bits: do not accept 110.

QUESTION	ANSWER	MARKS	GUIDANCE
4(a) J277 1.2.4	Fan speed: 100 Window opening: 10101010 Light level: 254 Water timer: 00100001	**4**	1 mark per box. 64 + 32 + 4 = 100; 128 + 32 + 8 + 2 = 170; 128+64+32+16+8+4+2 = 254; 32 + 1 = 33. Binary answers must be 8 bits: do not accept 100001.
5(a) J277 1.2.4	The bits are written backwards / in reverse order The place values have been put the wrong way round / the 128 column (MSB) should be on the left / the smallest place value has been put on the left 10011100	**3**	1 mark per bullet, Max 3. Correct binary must be given for the third mark: 128 + 16 + 8 + 4 = 156. Accept "they used 1 2 4 8 ... from the left" for MP2. Do not accept "they added wrongly" or "they got the 1s and 0s wrong" on its own. (00111001 is actually 57.)
6(a) J277 1.2.4	31	**1**	11111 = 16 + 8 + 4 + 2 + 1 = 31. Do not accept 32.
6(b) J277 1.2.4	The largest number in 8 bits is 255 / 11111111 300 is larger than 255 / 300 needs more than 8 bits / needs 9 bits / needs a 256 column	**2**	1 mark per bullet, Max 2. Accept "300 is bigger than the maximum 8-bit number" for MP2 only. 300 = 100101100 (9 bits).

Total: 20 marks

MODULE C DATA REPRESENTATION · C3

Hexadecimal: mark scheme

21 marks · OCR J277 spec 1.2.4

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative words; **//** separates alternative answers for the same mark. Words in (brackets) are not needed. Ignore case in hex. Ignore leading 0s unless stated. A correct final answer with no working gets full marks, including where "Show your working" is asked: the working mark credits a correct method when the final answer is wrong.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) J277 1.2.4	16	**1**	Accept "0 to 9 and A to F". Do not accept 15.
1(b) J277 1.2.4	12	**1**	Correct answer only (A = 10, B = 11, C = 12).
1(c) J277 1.2.4	FF 255	**2**	1 mark each. 15 × 16 + 15 = 255. Do not accept 256.
2(a) J277 1.2.4	4B	**1**	75 ÷ 16 = 4 remainder 11; 11 = B. Do not accept B4 (reversed) or 411.
2(b) J277 1.2.4	160 ÷ 16 = 10 remainder 0 // 10 × 16 = 160 // 10 = A A0	**2**	1 mark working, 1 mark answer. Do not accept A, 0A or 100: the trailing 0 must be there (a common error in OCR examiners' reports). Working mark can be given when the answer is wrong.
2(c) J277 1.2.4	0D	**1**	Accept D (leading 0). Do not accept D0 or 13.
3(a) J277 1.2.4	46	**1**	2 × 16 = 32; E = 14; 32 + 14 = 46.
3(b) J277 1.2.4	B = 11 and 11 × 16 = 176 // 176 + 7 183	**2**	1 mark working, 1 mark answer. 176 + 7 = 183. Do not accept 117 (11 and 7 written side by side).
3(c) J277 1.2.4	240	**1**	15 × 16 + 0 = 240. Do not accept 15.

QUESTION	ANSWER	MARKS	GUIDANCE
4(a) J277 1.2.4	100 → 64 30 → 1E 9C → 156 50 → 80	**4**	1 mark per row. 6 × 16 + 4 = 100; 1 × 16 + 14 = 30; 9 × 16 + 12 = 156; 5 × 16 + 0 = 80. Do not accept E1 (reversed), or 50 in the last row.

5(a)
J277 1.2.4
	The left digit is worth 16s / column values are 16 and 1 // multiply the left digit by 16: 3 × 16 = 48
	D = 13 // add the value of the right (units) digit, 13
	48 + 13 = 61
		3	1 mark per bullet. Allow a method via binary: each digit to a 4-bit nibble (0011 1101) for 1 mark, add the binary place values for 1 mark, 61 for 1 mark. 61 with no description = 1 mark only (the question asks to describe).

6(a) J277 1.2.4	196	**1**	C = 12; 12 × 16 + 4 = 196. Do not accept 124.
6(b) J277 1.2.4	3A	**1**	58 ÷ 16 = 3 remainder 10; 10 = A. Do not accept A3 (reversed) or 310.

Total: 21 marks

MODULE C DATA REPRESENTATION · C4

Converting binary and hexadecimal: mark scheme

20 marks · OCR J277 spec 1.2.4

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative answers. Words in (brackets) are not needed for the mark. Working is shown for the teacher. A correct final answer with no working gets full marks, including where the question says "Show your working" (OCR credits the answer; there is no separate working mark on these questions). Never credit hex digits in the wrong order, a reversed bit pattern, or a denary value (e.g. 10) written in place of a hex digit.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) J277 1.2.4	4 (bits)	**1**	Accept "a nibble". Correct answer only.
1(b) J277 1.2.4	9 (left nibble 1001 = 8 + 1 = 9) D (right nibble 1101 = 8 + 4 + 1 = 13 = D)	**2**	Answer 9D. 1 mark per correct digit in the correct position. D9 = 0. 913 = 1 mark (9 only). Denary 157 = 0.
1(c) J277 1.2.4	7 (0111 = 4 + 2 + 1) 0 (0000 = 0)	**2**	Answer 70. "7" alone = 1 mark (the all-zero nibble is still a digit). 07 = 0. Denary 112 = 0.
2(a) J277 1.2.4	0100 (4 = 4) 1100 (C = 12 = 8 + 4)	**2**	Answer 0100 1100 / 01001100. 1 mark per correct nibble in the correct position. 100 1100 (leading 0 missing, so not 8 bits) = 1 mark. Reversed pattern = 0.
2(b) J277 1.2.4	1111 (F = 15) 0011 (3 = 2 + 1)	**2**	Answer 1111 0011 / 11110011. 1 mark per correct nibble in the correct position. 1111 11 (3 not padded to 4 bits) = 1 mark.
3(a) J277 1.2.4	0010 1011 → 2B E8 → 1110 1000 1111 1111 → FF 06 → 0000 0110	**4**	1 mark per row. 2B: 0010 = 2, 1011 = 8 + 2 + 1 = 11 = B. E8: E = 14 = 8 + 4 + 2 = 1110, 8 = 1000. FF: 1111 = 15 = F twice. 06: 0 = 0000, 6 = 4 + 2 = 0110. Binary must be 8 bits (110 alone = 0). Do not accept 211 for 2B or 1515 for FF.

QUESTION	ANSWER	MARKS	GUIDANCE
4(a) J277 1.2.4	Wrote the denary value 10 instead of the hex digit A (for the first nibble 1010)	**1**	Accept: did not convert 10 to A / did not use a letter for 10 to 15. Do not accept "it is wrong" or "converted to denary" with no reference to 10 / A / the first nibble.
4(b) J277 1.2.4	A1	**1**	1010 = 8 + 2 = 10 = A; 0001 = 1. 1A = 0.
5(a) J277 1.2.4	Split the 8 bits into two nibbles / two groups of 4 bits Convert each nibble to denary using place values 8, 4, 2, 1 Write each nibble as one hex digit, using A to F for 10 to 15, keeping the left nibble first A correct worked example, e.g. 1011 0110 → 11 and 6 → B6	**3**	Max 3. The example mark needs a fully correct conversion. Also accept the method: convert the 8 bits to denary, divide by 16; the whole-number result is the first digit and the remainder the second, each written in hex (e.g. 1011 0110 = 182 = 11 × 16 + 6 → B6). One mark per correct step of either method.
6(a) J277 1.2.4	C7	**1**	1100 = 12 = C; 0111 = 7. (7C reverses the nibbles; CF = 1100 1111.) 2+ ticks = 0.
6(b) J277 1.2.4	FF	**1**	1111 1111 = FF (= 255 in denary). Do not accept 255 or 1515.

Total: 20 marks

MODULE C DATA REPRESENTATION · C5

Binary addition and overflow: mark scheme

20 marks · OCR J277 spec 1.2.4

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative words; **//** separates alternative answers. Words in (brackets) are not needed for the mark. In the grids, the carry row shows each carry under the column it is carried **into** (the dashed column is the overflow bit); carries written above the numbers are equally fine. Working marks are only for binary carries: converting to denary and back earns no working mark. These questions say "Show your working", so a correct answer with no carries earns the answer mark only (as in J277 mark schemes).

<table>
<tr><th>QUESTION</th><th>ANSWER</th><th>MARKS</th><th>GUIDANCE</th></tr>
<tr><td>1(a)
J277 1.2.4</td><td>10</td><td>1</td><td>Accept 0 carry 1. Do not accept 2 (not binary).</td></tr>
<tr><td>1(b)
J277 1.2.4</td><td>255</td><td>1</td><td>Correct answer only. Do not accept 256.</td></tr>
<tr><td>2(a)
J277 1.2.4</td><td>1 mark per bullet:
Working: carries shown correctly (into the 8, 16, 32, 64 and 128 columns)
10000011
<table><tr><th></th><th>128</th><th>64</th><th>32</th><th>16</th><th>8</th><th>4</th><th>2</th><th>1</th><th></th></tr><tr><td></td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td></td></tr><tr><td></td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>+</td></tr><tr><td></td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>Answer</td></tr><tr><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td></td><td></td><td></td><td>Carries</td></tr></table></td><td>2</td><td>Correct answer with no carries: 1 mark. Check: 53 + 78 = 131.</td></tr>
<tr><td>3(a)
J277 1.2.4</td><td>1 mark per bullet:
Working: carries shown correctly (into the 4, 8, 16, 32 and 64 columns)
11010001
<table><tr><th></th><th>128</th><th>64</th><th>32</th><th>16</th><th>8</th><th>4</th><th>2</th><th>1</th><th></th></tr><tr><td></td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td></td></tr><tr><td></td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>+</td></tr><tr><td></td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>Answer</td></tr><tr><td></td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td></td><td></td><td>Carries</td></tr></table></td><td>2</td><td>As 2(a). Check: 150 + 59 = 209.</td></tr>
</table>

<table>
<tr><th>QUESTION</th><th>ANSWER</th><th>MARKS</th><th>GUIDANCE</th></tr>
<tr><td>3(b)
J277 1.2.4</td><td>1 mark per bullet:
Working: carries shown correctly, including the final carry out of the 128 column
(1) 00100001
<table>
<tr><th></th><th>128</th><th>64</th><th>32</th><th>16</th><th>8</th><th>4</th><th>2</th><th>1</th><th></th></tr>
<tr><td></td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td></td></tr>
<tr><td></td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>+</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>Answer</td></tr>
<tr><td>1</td><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td></td><td></td><td></td><td>Carries</td></tr>
</table></td><td>2</td><td>Accept 100100001 (9 bits) or 00100001 for the answer mark. The working mark needs the final carry out of the 128 column. Check: 204 + 85 = 289; 289 − 256 = 33 = 00100001.</td></tr>
<tr><td>3(c)
J277 1.2.4</td><td>Overflow (error)</td><td>1</td><td>Do not accept "carry" alone.</td></tr>
<tr><td>3(d)
J277 1.2.4</td><td>1 mark per bullet to max 2:
The result / 289 is larger than 255 // larger than the maximum 8 bits can hold
The 128 column produces a carry // the answer needs a 9th bit
The register only has 8 bits // there is no space to store the extra bit
(So) the extra bit is not stored // the total stored is wrong (33)</td><td>2</td><td>Max 2. "The number is too big" alone is NE: it must be too big for 8 bits / 255.</td></tr>
<tr><td>4(a)
J277 1.2.4</td><td>01111111 + 00000001: No overflow error
10000000 + 10000000: Overflow error
01010101 + 00101010: No overflow error
11110000 + 00010001: Overflow error</td><td>4</td><td>1 mark per row. 2 ticks in a row = 0 for that row. Checks: 127 + 1 = 128; 128 + 128 = 256; 85 + 42 = 127; 240 + 17 = 257.</td></tr>
<tr><td>5(a)
J277 1.2.4</td><td>First number: 1 (giving 01011010)
Second number: 0 (giving 10010110)</td><td>2</td><td>1 mark per correct bit, in the correct number. Check: 90 + 150 = 240 = 11110000; the other three choices give 232, 296 and 304, so the answer is unique.</td></tr>
<tr><td>6(a)
J277 1.2.4</td><td>1 mark per bullet to max 3:
140 + 120 = 260, which is more than 255 // too large for 8 bits
An overflow error occurs // the extra / 9th bit cannot be stored
The stored total is wrong // it shows 4 (floors) // much less than was climbed
The user sees an incorrect / misleading count // a daily goal is not recorded
The program may crash / behave unexpectedly</td><td>3</td><td>Max 3. For 3 marks at least one point must be about the floors / the user. Check: 260 − 256 = 4.</td></tr>
</table>

Total: 20 marks

MODULE C DATA REPRESENTATION · C6

Binary shifts: mark scheme

19 marks · OCR J277 spec 1.2.4

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative answers. Words in (brackets) are not needed for the mark. Every shift was checked by program. A correct final answer with no working earns full marks. J277 says "binary shift"; accept "logical shift" too. Bits shifted off the end are lost: never credit a binary point.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) J277 1.2.4	The number is multiplied by 2 / doubled	**1**	Accept ×2. Do not accept "gets bigger" alone.
1(b) J277 1.2.4	The number is divided by 4	**1**	Accept ÷4 / halved twice / divided by 4 (rounded down). Do not accept ÷2.
1(c) J277 1.2.4	0 / zero	**1**	Correct answer only.
2(a) J277 1.2.4	01101000	**1**	Working: 00011010 (26) → 00110100 → 01101000 (104 = 26 × 4). Must be 8 bits in the correct order. Do not accept 00000110 (shifted right).
2(b) J277 1.2.4	00001110	**1**	Working: 01110000 (112) → 00001110; only 0s are lost. Do not accept 10000000 (shifted left).
2(c) J277 1.2.4	14	**1**	8 + 4 + 2 = 14 (= 112 ÷ 8). Follow through from a wrong 8-bit answer to (b), converted correctly.
3(a) J277 1.2.4	00101100	**1**	Working: every bit moves one place right; the 1 in the 1s column is shifted off the end and lost; a 0 fills the gap on the left. Do not accept 00101100.1 or any answer with a binary point (not on the J277 specification; OCR examiners' report, June 2022).

QUESTION	ANSWER	MARKS	GUIDANCE
3(b) J277 1.2.4	44	**1**	32 + 8 + 4 = 44. Follow through from (a).
3(c) J277 1.2.4	The right-most / least significant bit was a 1 and it is shifted off the end / lost (Only 8 bits / whole numbers are kept, so) the half / 0.5 is lost / the result is rounded down	**2**	1 mark per bullet, max 2.
4(a) J277 1.2.4	Left 3 (places)	**2**	1 mark direction, 1 mark places. 7 → 56 = ×8. "Multiplied by 8" with no direction or places = 1.
4(b) J277 1.2.4	Right 4 (places)	**2**	1 mark direction, 1 mark places. 160 → 10 = ÷16. "Divided by 16" with no direction or places = 1.
5(a) J277 1.2.4	(Shift) left 4 places	**2**	1 mark direction, 1 mark places ($16 = 2^4$). "Right 4": award the places mark only.
6(a) J277 1.2.4	00001101	**1**	52 → 13 (÷4). 11010000 = left 2; 00011010 = right 1; 00001110 is not a shift of 00110100. 2+ ticks = 0.
7(a) J277 1.2.4	Each column / place value is double / twice the one to its right Moving every bit one place left puts each 1 in a column worth twice as much (so the total doubles) The 0 that fills the gap on the right adds nothing	**2**	1 mark per bullet, max 2. "Because it moves left" alone = 0.

Total: 19 marks

MODULE C DATA REPRESENTATION · C8

Character sets: ASCII and Unicode: mark scheme

20 marks · OCR J277 spec 1.2.4

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative answers. Words in (brackets) are not needed for the mark. Every code and binary pattern was checked by program (Python ord() and format()). Candidates are not expected to remember codes (J277: memorisation of codes not required). A correct final answer with no working earns full marks, including Q4: OCR credits the correct characters even where "show your working" is asked. Never credit a reversed bit pattern.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) J277 1.2.4	All the characters a computer can represent / recognise (each with its own unique binary code)	**1**	Accept "a defined list of characters and the binary codes that represent them". Do not accept "the alphabet" alone.
1(b) J277 1.2.4	8 (bits) / 1 byte / 7 (bits)	**1**	Accept 7 (standard ASCII) or 8 (as ASCII is written in the J277 exam). Do not accept 16 or 32.
2(a) J277 1.2.4	70	**1**	Working: C 67, D 68, E 69, F 70; codes are in order, so count on 1 per letter.
2(b) J277 1.2.4	01000101	**1**	Working: E = 69 = 64 + 4 + 1. Must be 8 bits in the correct order. Do not accept 01000110 (F) or 10100010 (reversed).
2(c) J277 1.2.4	Upper case and lower case are different characters, so each has its own (unique) code	**1**	Accept "f has a different code" with a reason. The value (102) is not needed.
3(a) J277 1.2.4	B: 01000010 A: 01000001 G: 01000111	**3**	Working: count on from A = 65: B = 66 (64 + 2), G = 71 (64 + 4 + 2 + 1). 1 mark per correct row, each 8 bits in the correct order.
4(a) J277 1.2.4	01100011 = 99 = c 01100001 = 97 = a 01100010 = 98 = b	**3**	Answer: **cab**. Working: 64 + 32 + 2 + 1 = 99; 64 + 32 + 1 = 97; 64 + 32 + 2 = 98; 97 is a, so 98 is b and 99 is c. 1 mark per correct character in the correct position. Upper case (CAB): max 2.

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) J277 1.2.4	256	**1**	2^8 = 256. Do not accept 255.
5(b) J277 1.2.4	16	**1**	2^4 = 16. Do not accept 15 or 8.
5(c) J277 1.2.4	The more bits per character, the more characters can be represented Each extra bit doubles the number of codes / characters = $2^{\text{number of bits}}$	**2**	Max 2. Accept a correct example, e.g. 7 bits = 128, 8 bits = 256. Do not credit "more bits, fewer characters" (a common error, OCR examiners' report June 2025).
6(a) J277 1.2.4	Can represent more / a greater range of characters Can represent other languages / alphabets / emojis / symbols	**1**	Max 1. Do not accept "faster" or "smaller files".
6(b) J277 1.2.4	Uses more bits per character (So) text needs more storage / larger files / more data to send	**1**	Max 1. Do not accept "fewer characters" or "fewer bits".
6(c) J277 1.2.4	ASCII (8 bits) can only represent 256 characters … not enough for the characters of Chinese / Arabic ASCII has no codes for emojis Unicode uses more bits per character (up to 32) … so it has far more codes / covers most languages and emojis So every customer's message displays correctly	**3**	Max 3. A generic answer not linked to the languages or emojis in the scenario: max 2. Accept 16 or 32 bits for Unicode.

Total: 20 marks

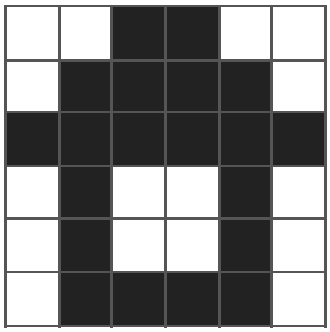
MODULE C DATA REPRESENTATION · C9

Representing images: mark scheme

21 marks · OCR J277 spec 1.2.4

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative answers. Words in (brackets) are not needed for the mark. Every bit pattern and power of 2 was checked by program. A correct final answer with no working earns full marks.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) J277 1.2.4	The smallest element / single point / single (coloured) square of a (bitmap) image	**1**	Accept "one dot of colour in an image". Do not accept "a bit".
1(b) J277 1.2.4	The number of bits used (to store the colour of) each pixel	**1**	Accept "bits per pixel". Do not accept "the number of colours" on its own.
1(c) J277 1.2.4	The number of pixels in the image / width × height in pixels	**1**	Accept the height or width in pixels, or the number of pixels per inch / pixel density (ppi). Do not accept "how clear the image is" on its own.
2(a) J277 1.2.4	Data about data / about the image	**1**	Accept "extra information stored about the image".
2(b) J277 1.2.4	Width (in pixels) Height (in pixels) Colour depth / bits per pixel Resolution File type / format Date taken / created (Camera) location / GPS	**2**	Max 2. 1 mark per item. Accept "dimensions" for one mark only. Do not accept the pixel data itself.
2(c) J277 1.2.4	So the computer knows where each row ends / how many pixels are in a row / how to arrange the pixels (width / height) So the computer knows how many bits make one pixel / how to read each pixel's colour (colour depth) So the image is reconstructed / displayed correctly	**2**	Max 2. 1 mark for a reason, 1 for expansion linked to width / height or colour depth.

QUESTION	ANSWER	MARKS	GUIDANCE
3(a) J277 1.2.4	All 6 rows correct (see grid below) At least 4 rows correct 	**2**	Rows: 001100, 011110, 111111, 010010, 010010, 011110 (36 bits, 6 per row, checked by program). 2 marks all six rows; 1 mark four or five rows correct. Inverted colours (0s shaded) = 0.
3(b) J277 1.2.4	2 (bits)	**1**	$2^2 = 4$. Do not accept 4.
3(c) J277 1.2.4	8	**1**	$2^3 = 8$. Do not accept 6 or 3.
4(a) J277 1.2.4	6 (bits)	**1**	$2^5 = 32$ is too few; $2^6 = 64$, which is at least 50. Do not accept 5 or 50.
5(a) J277 1.2.4	True False False True	**4**	1 mark per row. Row 2: 8 bits give $2^8 = 256$ colours. Row 3: colour depth changes the bits per pixel, not the number of pixels. Two ticks in one row = 0 for that row.
6(a) J277 1.2.4	Lower resolution means fewer pixels / less detail ... so the image looks blockier / more pixelated / lower quality (especially when enlarged) Lower colour depth means fewer bits per pixel / fewer colours can be shown ... so colours are less accurate / shading is less smooth / lower quality Both changes mean fewer bits are stored ... so the file size is smaller / uploads faster / uses less storage	**4**	Max 4. Max 3 if only quality or only file size is addressed. Max 3 if only one of resolution / colour depth is addressed. Do not credit "blockier" for colour depth, or any claim that file size increases. (Calculating the file size is covered in B8.)

Total: 21 marks

MODULE C DATA REPRESENTATION · C10

Representing sound: mark scheme

21 marks · OCR J277 spec 1.2.4

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative answers. Words in (brackets) are not needed for the mark. J277 uses "bit depth"; accept "sample resolution". Accept "accuracy" for playback quality.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) J277 1.2.4	The number of samples taken per second / each second	**1**	Do not accept "how often the sound is sampled" without "per second". Do not accept the frequency/pitch of the sound wave (common error).
1(b) J277 1.2.4	Hertz / Hz	**1**	Accept kHz.
1(c) J277 1.2.4	The number of bits (used) to store each sample	**1**	Accept "bits per sample". Do not accept "number of bits in the file".
2(a) J277 1.2.4	analogue amplitude regular binary	**4**	1 mark per gap, in this order. Do not accept "digital" for gap 1 or "frequency" for gap 2 (the frequency of the wave is not what is measured).
3(a) J277 1.2.4	8	**1**	Working: $2^3 = 8$.
3(b) J277 1.2.4	16	**1**	Working: $2^4 = 16$ (each extra bit doubles the number of values). Do not accept 9 or 12.
4(a) J277 1.2.4	Sample rate increased: quality better, file larger Bit depth decreased: quality worse, file smaller Duration increased: quality same, file larger Sample rate decreased: quality worse, file smaller	**4**	1 mark per row; both ticks in the row must be correct. More than one quality tick or more than one size tick in a row = 0 for that row.

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) J277 1.2.4	Fewer samples are taken per second / samples are further apart so the digital copy is less like / less accurate to the original (analogue) wave / changes in the sound between samples are missed	**2**	1 mark per bullet. The second mark needs the link to accuracy. Do not accept "lower bit depth" (both have the same bit depth).
5(b) J277 1.2.4	The file size increases / doubles so more storage space is needed / it takes longer to send or download	**2**	1 mark for the effect, 1 for the consequence. Doubling checked: 16 ÷ 8 = 2, with sample rate and duration unchanged. Working out actual file sizes is practised in B8 and not required here.
6(a) J277 1.2.4	The file size is larger / doubled	**1**	Accept twice as big. Checked: 4 ÷ 2 = 2, so twice as many samples.
6(b) J277 1.2.4	The sample rate and bit depth are the same so each second is stored with the same accuracy / the extra length only adds more samples	**2**	1 mark per bullet. Do not accept "because it is longer" alone.
6(c) J277 1.2.4	Decrease the sample rate / decrease the bit depth	**1**	Must give the setting and the direction. Do not accept shortening the recording (it must stay 4 minutes). Do not accept compression (C11).

Total: 21 marks

MODULE C DATA REPRESENTATION · C11

Compression, lossy and lossless: mark scheme

20 marks · OCR J277 spec 1.2.5

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative words; **//** separates alternative answers. Words in (brackets) are not needed for the mark. J277 does not require any specific compression method, so none is asked for. Credit the type (lossy / lossless); do not accept a file format in place of the type.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) J277 1.2.5	Takes up less storage space Quicker to send / upload / download // shorter transmission time Uses less bandwidth Can fit under a file size limit (e.g. for email attachments)	**2**	Max 2. Do not accept "faster" alone without saying what is faster. Do not accept "more secure".
2(a) J277 1.2.5	Row 1: Lossy Row 2: Lossless Row 3: Lossy Row 4: Lossless	**4**	1 mark per row. Two ticks in a row = 0 for that row.
3(a) J277 1.2.5	Lossless (1) No data is lost / the original file is restored exactly Text needs every character to be kept // lossy would remove data, so characters / words would be lost or changed The file could be corrupted / might not open / the agreement would be wrong if any data was lost	**3**	1 mark for lossless, then max 2 for the justification. If lossy is given, 0 marks for the whole part. Do not accept "the text would go blurry" (lossy does not blur letters; OCR examiners' report, June 2022).
3(b) J277 1.2.5	Lossy (1) Gives a much smaller file // smaller than lossless So the photos / pages load quicker for visitors // use less bandwidth / storage A small loss of quality is unlikely to be noticed // the photos still look acceptable	**3**	1 mark for lossy, then max 2 for the justification. Lossless with a valid reason (e.g. the photos must keep full quality) scores max 2. Do not accept "no data is removed" as a reason for lossy.
4(a) J277 1.2.5	Data is permanently removed / the original cannot be restored Quality may be reduced (e.g. a blockier image, poorer sound) Not suitable for text / program files	**1**	Max 1.
4(b) J277 1.2.5	The compressed file is (usually) larger than with lossy Does not reduce the file size as much // needs more storage / bandwidth / time to send than lossy	**1**	Max 1. Do not accept "loses data" (reversed).

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) J277 1.2.5	Lossy permanently removes data (from the file) A program needs every bit / instruction to be exactly the same So the program would be corrupted / would not run / would not work (correctly)	**2**	Max 2. Do not accept "lower quality" alone.
6(a) J277 1.2.5	*Advantages* Much smaller files (than lossless) So songs stream / download quicker // less buffering Uses less bandwidth / mobile data // less storage on phones / servers Small losses in quality may not be noticed by listeners *Disadvantages* Data is permanently removed / the original cannot be restored Sound quality may be lower // listeners may notice the drop in quality	**4**	Max 4. At least 1 advantage and 1 disadvantage needed for full marks; otherwise max 3. Headings in italics are not marking points.

Total: 20 marks