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