MODULE C DATA REPRESENTATION · C6

Logical binary shifts: mark scheme

19 marks · Cambridge 0478 syllabus 1.1.5

How to use. One mark per creditworthy point up to the maximum shown. **/** separates alternative words; **//** 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. Bits shifted from the end of the register are lost and zeros are shifted in at the opposite end.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 1.1.5	10101000	**1**	Working: 00010101 (21) → 10101000 (168 = 21 × 8); three 0s lost on the left, three 0s in on the right. Do not accept 00000010 (shifted right).
1(b) 0478 1.1.5	00110011	**1**	Working: 11001100 (204) → 00110011 (51 = 204 ÷ 4); two 0s lost on the right. Do not accept 00110000 (shifted left).
2(a) 0478 1.1.5	Multiplied by 4	**1**	2+ ticks = 0.
2(b) 0478 1.1.5	Divided by 16	**1**	2+ ticks = 0.
3(a) 0478 1.1.5	Row 1: 01011010 Row 2: 00000011 Row 3: 10110000 Row 4: 01001011	**4**	1 mark per row. Checks: 45 → 90; 96 → 3 (96 ÷ 32); 11 → 176 (11 × 16); 150 → 75. Each must be 8 bits in the correct order.
4(a) 0478 1.1.5	10100100	**1**	The most significant 1 is shifted off the end and lost; a 0 moves in on the right.
4(b) 0478 1.1.5	164	**1**	128 + 32 + 4 = 164. Follow through from (a).
4(c) 0478 1.1.5	The most significant bit / the 1 in the 128 column is shifted off the end / lost The register only holds 8 bits // 420 needs 9 bits // 420 is larger than 255 (the largest 8-bit value)	**2**	Any 2 from. Accept 420 − 256 = 164 as evidence for the first mark.
5(a) 0478 1.1.5	111	**1**	The three least significant bits (the 4, 2 and 1 columns). Accept "three 1s".

QUESTION	ANSWER	MARKS	GUIDANCE
5(b) 0478 1.1.5	The least significant bits / the 1s at the right end are lost (The register holds whole numbers only, so) the fraction / 0.875 / remainder is lost // the result is rounded down	**2**	Any 2 from.
6(a) 0478 1.1.5	0 / zeros	**1**	Correct answer only.
6(b) 0478 1.1.5	(Logical) right shift 5 places	**2**	$32 = 2^5$. 1 mark direction, 1 mark places.
6(c) 0478 1.1.5	They are lost	**1**	Accept "discarded". Do not accept "moved to the other end" (that is a rotation, not a logical shift).

Total: 19 marks