

WA8MNAA1

Algebraic techniques

Core + Challenge

Power of a Power and the Zero Index — Marking Key

I can raise powers and products to a power, use the zero index, and combine the index laws to simplify.

For tutors and parents. Award method marks for correct working even if the final answer is wrong.

Marks summary

Section A Fluency: 16 Section B Core: 22 Section C Reasoning: 9 Section D Challenge: 11 **Total: 58**

Fluency: 1 mark each; accept an equivalent unsimplified answer for half credit at tutor's discretion.

A

Fluency *answers and working*

/ 16 marks

Q	Answer	Working
1	2^{12}	$3 \times 4 = 12$
2	a^{10}	$5 \times 2 = 10$
3	x^{12}	$4 \times 3 = 12$
4	m^{14}	$2 \times 7 = 14$
5	1	any non-zero base ⁰ = 1
6	a^4b^4	each factor to the power 4
7	$9x^2$	$3^2 \times x^2$
8	$8a^9$	$2^3 = 8$; $3 \times 3 = 9$
9	5	5×1 (only x has index 0)
10	1	the whole bracket has index 0
11	$4y^8$	$(-2)^2 = 4$; $4 \times 2 = 8$
12	a^8b^{12}	2×4 ; 3×4
13	2	$1 + 1$
14	1 000 000	10^6
15	x^{10}	$x^6 \times x^4$
16	y^7	$y^{12} \div y^5$

B

Core answers, working and marks

/ 22 marks

Q	Answer	Working / sample response	Marks
1	$5^6 = 15\,625$	$2 \times 3 = 6$ $5^6 = 15\,625$ 1 mark: 5^6 1 mark: 15 625	2
2	$9a^8 \text{ cm}^2$	$(3a^4)^2 = 3^2 \times a^8$ 1 mark: 9 1 mark: a^8	2
3	$8k^6 \text{ cm}^3$	$(2k^2)^3 = 2^3 \times k^6$ 1 mark: 8 1 mark: k^6	2
4	$4x^7$	$(2x^3)^4 = 16x^{12}$ $16x^{12} \div 4x^5 = 4x^7$ 1 mark: $16x^{12}$ 1 mark: $4x^7$	2
5	$27a^6b^3$	$3^3 = 27$; $a^2 \times 3 = a^6$; $b^1 \times 3 = b^3$ 1 mark: 27 1 mark: a^6b^3	2
6	8	$1 + 8 \times 1 - 1$ $= 8$ 1 mark: each zero power is 1 1 mark: 8	2
7	(a) $n = 6$ (b) $k = 7$	(a) $30 \div 5 = 6$ (b) $21 \div 3 = 7$ 1 mark each	2
8	4^6 and 8^4	$4^6 = (2^2)^6 = 2^{12}$ $8^4 = (2^3)^4 = 2^{12}$ 1 mark: idea $4 = 2^2$, $8 = 2^3$ 1 mark: 4^6 1 mark: 8^4	3
9	m^2	$m^{12} \times m^{10} = m^{22}$ $m^{22} \div m^{20} = m^2$ 1 mark: m^{22} 1 mark: m^2	2
10	$6p^5 \text{ cm}$	$6 \times 6 = 36$ and $5 \times 2 = 10$ Check: $(6p^5)^2 = 36p^{10}$ 1 mark: 6 1 mark: p^5 1 mark: check	3

C Reasoning *sample answers and marking criteria*

/ 9 marks

Q	Answer	Working / sample response	Marks
1	a^{12}	He added the indices. $(a^4)^3 = a^4 \times a^4 \times a^4$, so the indices are multiplied: $4 \times 3 = 12$. <i>1 mark: explains error</i> <i>1 mark: a^{12}</i>	2
2	Both equal 1	By the division law, $5^3 \div 5^3 = 5^0$ ($3 - 3 = 0$). But $125 \div 125 = 1$, so 5^0 must equal 1. <i>1 mark: index law gives 5^0</i> <i>1 mark: number divided by itself is 1</i>	2
3	False	$(2a)^3 = 2^3 \times a^3 = 8a^3$. The 2 must be cubed too. Check $a = 1$: $(2 \times 1)^3 = 8$ but $2 \times 1^3 = 2$. <i>1 mark: false</i> <i>1 mark: reason</i>	2
4	Mia is wrong	$(3 + 4)^2 = 7^2 = 49$, but $3^2 + 4^2 = 9 + 16 = 25$ The power-of-a-product law applies to factors multiplied together, not to terms added together. <i>1 mark: 49</i> <i>1 mark: 25</i> <i>1 mark: explanation</i>	3

D Challenge *solutions and marking criteria*

/ 11 marks

Q	Answer	Working / sample response	Marks
1	$x = 8$	$(2^x)^3 = 2^{3x}$, $4^x = (2^2)^x = 2^{2x}$ $2^{3x} \times 2^{2x} = 2^{5x}$ $5x = 40$, so $x = 8$ <i>1 mark: 2^{3x}</i> <i>1 mark: 2^{2x}</i> <i>1 mark: $x = 8$</i>	3
2	$5^{20}, 2^{60}, 3^{40}$	$2^{60} = (2^3)^{20} = 8^{20}$ $3^{40} = (3^2)^{20} = 9^{20}$ $5^{20} < 8^{20} < 9^{20}$ <i>1 mark: 8^{20}</i> <i>1 mark: 9^{20}</i> <i>1 mark: order</i>	3
3	$12a^3b^4$	$8a^9b^6 \times 9a^2b^8 = 72a^{11}b^{14}$ $72a^{11}b^{14} \div 6a^8b^{10} = 12a^3b^4$ <i>1 mark: $72a^{11}b^{14}$</i> <i>1 mark: $12a^3b^4$</i>	2

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Q	Answer	Working / sample response	Marks
4	12 digits	$4^5 = (2^2)^5 = 2^{10}$ $2^{10} \times 5^{12} = (2 \times 5)^{10} \times 5^2 = 10^{10} \times 25$ 25 followed by 10 zeros: 12 digits <i>1 mark: 2^{10}</i> <i>1 mark: 25×10^{10}</i> <i>1 mark: 12</i>	3