

Laws of Indices

Solutions

For AQA GCSE Mathematics (8300) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (1 mark)

Write $3 \times 3 \times 3 \times 3 \times 3$ as a power of 3

Count the 3s being multiplied: there are five.

So the power is 5.

Answer: 3^5

2 (4 marks)

Write each answer as a single power.

(a) $5^3 \times 5^4$

When you multiply powers of the same number, add the powers.

$$3 + 4 = 7$$

$$5^3 \times 5^4 = 5^7$$

Answer: 5^7

Tip: Keep the base the same. $5^3 \times 5^4 = 5^7$, not 25^7 and not 5^{12} .

(b) $7^9 \div 7^2$

When you divide powers of the same number, subtract the powers.

$$9 - 2 = 7$$

$$7^9 \div 7^2 = 7^7$$

Answer: 7^7

(c) $(3^2)^5$

A power of a power: multiply the powers.

$$2 \times 5 = 10$$

$$(3^2)^5 = 3^{10}$$

Answer: 3^{10}

Tip: For a bracket raised to a power, multiply the powers (2×5), do not add them.

(d) $4^6 \times 4$

4 is the same as 4^1 .

So add the powers: $6 + 1 = 7$

$$4^6 \times 4^1 = 4^7$$

Answer: 4^7

3 (2 marks)

Write $25^2 \times 5^3$ as a power of 5

The bases are different, so first write 25 as a power of 5.

$$25 = 5 \times 5 = 5^2$$

$$\text{So } 25^2 = (5^2)^2 = 5^{2 \times 2} = 5^4$$

Now add the powers: $5^4 \times 5^3 = 5^{4+3} = 5^7$

Answer: 5^7

Tip: You can only add the powers when the bases are the same. Change 25 into 5^2 first.

Marks: 1 mark for writing 25^2 as 5^4 (or 25 as 5^2). 1 mark for 5^7 .

4 (1 mark)

Write $10^3 \times 1000$ as a power of 10

$$1000 = 10 \times 10 \times 10 = 10^3$$

$$\text{So } 10^3 \times 1000 = 10^3 \times 10^3$$

Add the powers: $3 + 3 = 6$

$$= 10^6$$

Answer: 10^6

5 (1 mark)

Work out $(2^3 \times 2^2) \div 2^4$

Brackets first. Add the powers: $2^3 \times 2^2 = 2^5$

Then subtract the powers: $2^5 \div 2^4 = 2^1$

$$2^1 = 2$$

Answer: 2

6 (1 mark)

Circle the value of 6^0

Options: 0, 1, 6, $\frac{1}{6}$

Any number (except 0) to the power 0 is 1.

You can see why: $6^2 \div 6^2 = 6^0$, and $36 \div 36 = 1$.

Answer: 1

Tip: 6^0 is not 6×0 . Any number to the power 0 equals 1.

7 (2 marks)

Write $3^{10} \div 9$ as a single power of 3

First write 9 as a power of 3.

$$9 = 3 \times 3 = 3^2$$

$$\text{So } 3^{10} \div 9 = 3^{10} \div 3^2$$

Subtract the powers: $10 - 2 = 8$

$$= 3^8$$

Answer: 3^8

Tip: Do not divide the power by 9. Write 9 as 3^2 , then subtract the powers.

Marks: 1 mark for $9 = 3^2$. 1 mark for 3^8 .

8 (1 mark)

$$2^4 \times 2^n = 2^{11}$$

Work out the value of n .

When you multiply, you add the powers.

$$\text{So } 4 + n = 11$$

$$n = 11 - 4 = 7$$

Answer: 7

9 (2 marks)

$$\frac{5^8}{5^3} = 5^{n-1}$$

Work out the value of n .

Simplify the left side. When you divide, subtract the powers.

$$\frac{5^8}{5^3} = 5^{8-3} = 5^5$$

$$\text{So } 5^5 = 5^{n-1}$$

The powers must be equal: $n - 1 = 5$

$$n = 6$$

Answer: 6

Marks: 1 mark for 5^5 . 1 mark for 6.

10 (2 marks)

Tick **one** box for each statement.

	True	False
$4^3 \times 4^2 = 4^5$	✓	
$2^3 \times 3^2 = 6^5$		✓
$9^6 \div 9^3 = 9^2$		✓
$(2^4)^2 = 2^8$	✓	

$$4^3 \times 4^2 = 4^{3+2} = 4^5 \quad \text{True}$$

$$2^3 \times 3^2 = 8 \times 9 = 72, \text{ but } 6^5 = 7776 \quad \text{False}$$

The bases are different, so you cannot add the powers.

$$9^6 \div 9^3 = 9^{6-3} = 9^3, \text{ not } 9^2 \quad \text{False}$$

$$(2^4)^2 = 2^{4 \times 2} = 2^8 \text{ True}$$

Tip: The index laws only work when the bases are the same, like $4^3 \times 4^2$. Never multiply the bases together.

Marks: 2 marks for all four correct. 1 mark for two or three correct.

11 (2 marks)

Work out the value of $\frac{3^7}{3^4 \times 3^2}$

Simplify the bottom first: $3^4 \times 3^2 = 3^{4+2} = 3^6$

Then divide: $3^7 \div 3^6 = 3^{7-6} = 3^1$

$$3^1 = 3$$

Answer: 3

Marks: 1 mark for 3^6 or 3^1 . 1 mark for 3.

12 (2 marks)

Work out the value of $2^{10} \div (2^3)^2$

Power of a power first: multiply the powers.

$$(2^3)^2 = 2^{3 \times 2} = 2^6$$

Then divide. Subtract the powers: $2^{10} \div 2^6 = 2^{10-6} = 2^4$

Now work out the value: $2^4 = 2 \times 2 \times 2 \times 2 = 16$

Answer: 16

Tip: “Work out the value” means you must give a number. Leaving the answer as 2^4 loses a mark.

Marks: 1 mark for 2^6 or 2^4 . 1 mark for 16.

13 (2 marks)

$$a = 2^5 \qquad b = 2^3$$

Write ab^2 as a power of 2

ab^2 means $a \times b^2$ (only b is squared).

$$b^2 = (2^3)^2 = 2^{3 \times 2} = 2^6$$

$$ab^2 = 2^5 \times 2^6$$

Add the powers: $5 + 6 = 11$

$$= 2^{11}$$

Answer: 2^{11}

Marks: 1 mark for $(2^3)^2 = 2^6$ or $2^5 \times 2^3 \times 2^3$. 1 mark for 2^{11} .
