

# Laws of Indices

## Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Foundation tier

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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.

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1 (4 marks)

Write as a single power

(a)  $6^4 \times 6^3$

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

$$4 + 3 = 7$$

$$6^4 \times 6^3 = 6^7$$

**Answer:**  $6^7$

**Tip:** Keep the base the same:  $6^7$ , not  $36^7$ . Add the powers, do not multiply them.

(b)  $2^{10} \div 2^4$

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

$$10 - 4 = 6$$

$$2^{10} \div 2^4 = 2^6$$

**Answer:**  $2^6$

(c)  $(5^3)^4$

A power of a power: multiply the powers.

$$3 \times 4 = 12$$

$$(5^3)^4 = 5^{12}$$

**Answer:**  $5^{12}$

**Tip:** For a bracket raised to a power, multiply the powers.  $5^7$  (adding them) is a common wrong answer.

(d)  $8^9 \div 8$

8 is the same as  $8^1$ .

So subtract the powers:  $9 - 1 = 8$

$$8^9 \div 8^1 = 8^8$$

**Answer:**  $8^8$

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**2** (2 marks)

Simplify  $\frac{7^5 \times 7^2}{7^3}$

Give your answer as a power of 7

Simplify the top first. Add the powers:  $7^5 \times 7^2 = 7^{5+2} = 7^7$

Then divide. Subtract the powers:  $7^7 \div 7^3 = 7^{7-3}$

$$= 7^4$$

**Answer:**  $7^4$

Marks: 1 mark for  $7^7$ . 1 mark for  $7^4$ .

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**3** (2 marks)

Write  $7^{-2} \times (7^3)^2$  as a power of 7

Work out the power of a power first. Multiply the powers:

$$(7^3)^2 = 7^{3 \times 2} = 7^6$$

Now multiply. Add the powers:

$$7^{-2} \times 7^6 = 7^{-2+6} = 7^4$$

**Answer:**  $7^4$

**Tip:** Take care with the negative power:  $-2 + 6 = 4$ , not 8 or  $-8$ .

*Marks:* 1 mark for  $7^6$ . 1 mark for  $7^4$ .

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**4** (1 mark)

$$3^2 \times 3^6 = 3^n$$

Work out the value of  $n$ .

When you multiply, add the powers.

$$3^2 \times 3^6 = 3^{2+6} = 3^8$$

$$\text{So } 3^8 = 3^n$$

$$n = 8$$

**Answer:** 8

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**5** (2 marks)

(a) Write down the value of  $15^0$

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

**Answer:** 1

**Tip:**  $15^0$  is not  $15 \times 0 = 0$ . Any number to the power 0 equals 1.

(b) Write  $\frac{1}{9}$  as a power of 3

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

$$\text{So } \frac{1}{9} = \frac{1}{3^2}$$

A negative power means “1 over”:  $\frac{1}{3^2} = 3^{-2}$

**Answer:**  $3^{-2}$

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**6** (2 marks)

$$4^3 \times 2^5 = 2^x$$

Work out the value of  $x$ .

The bases are different, so first write 4 as a power of 2.

$$4 = 2^2$$

$$\text{So } 4^3 = (2^2)^3 = 2^{2 \times 3} = 2^6$$

$$\text{Now add the powers: } 2^6 \times 2^5 = 2^{6+5} = 2^{11}$$

$$\text{So } x = 11$$

**Answer:** 11

**Tip:** You can only use the index laws when the bases are the same. Write every number as a power of 2 first.

*Marks:* 1 mark for  $4^3 = 2^6$ . 1 mark for 11.

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**7** (1 mark)

$$\text{Carl says } 5^6 \div 5^2 = 5^3$$

Explain why Carl is wrong.

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

Carl has divided them ( $6 \div 2 = 3$ ).

The correct answer is  $5^{6-2} = 5^4$ .

**Answer:** Powers are subtracted when dividing:  $5^4$

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**8** (2 marks)

Show that  $10^2 \div 10^5 = 0.001$

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

$$10^2 \div 10^5 = 10^{2-5} = 10^{-3}$$

A negative power means “1 over”:  $10^{-3} = \frac{1}{10^3} = \frac{1}{1000}$

$$\frac{1}{1000} = 0.001, \text{ as required.}$$

**Tip:**  $2 - 5 = -3$ , not 3. A negative power does not make the answer negative:  $10^{-3}$  is a small positive number.

*Marks:* 1 mark for  $10^{-3}$  (or  $\frac{100}{100\,000}$ ). 1 mark for fully correct working ending in 0.001.

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**9** (2 marks)

$$(4^n)^2 = 4^6 \times 4^4$$

Work out the value of  $n$ .

Simplify the right-hand side first. Add the powers:  $4^6 \times 4^4 = 4^{10}$

Power of a power on the left. Multiply the powers:  $(4^n)^2 = 4^{2n}$

So  $4^{2n} = 4^{10}$ , which means  $2n = 10$

$$n = 5$$

**Answer:** 5

**Tip:**  $(4^n)^2$  means  $4^n \times 4^n = 4^{2n}$ , so the power is  $2n$ , not  $n + 2$ .

*Marks:* 1 mark for  $4^{10}$  or  $4^{2n}$ . 1 mark for 5.

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**10** (2 marks)

Show that  $8^2 \times 4^3 = 2^{12}$

Write 8 and 4 as powers of 2.

$$8 = 2^3, \text{ so } 8^2 = (2^3)^2 = 2^6$$

$$4 = 2^2, \text{ so } 4^3 = (2^2)^3 = 2^6$$

Then add the powers:  $2^6 \times 2^6 = 2^{12}$ , as required.

*Marks:* 1 mark for  $2^6$  from either  $8^2$  or  $4^3$ . 1 mark for fully correct working ending in  $2^{12}$ .

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**11** (2 marks)

Work out the value of  $\frac{5^9}{5^4 \times 5^3}$

Simplify the bottom:  $5^4 \times 5^3 = 5^{4+3} = 5^7$

Then divide:  $5^9 \div 5^7 = 5^{9-7} = 5^2$

“The value” means work it out:  $5^2 = 25$

**Answer:** 25

**Tip:** “Work out the value” means give a number. Leaving the answer as  $5^2$  loses a mark.

*Marks:* 1 mark for  $5^7$  or  $5^2$ . 1 mark for 25.

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