

# GCSE Maths: Index notation and the laws of indices (Higher): answers

GCSE Maths - Standard Form, Indices and Surds - Higher - Lesson 6.1

**Answers.** Final answers to the worksheet questions. Full step-by-step solutions for every question are free at [websink.site/gcse/maths/ch06-standard-form-indices-surds/higher/index-notation-and-the-laws-of-indices/](https://websink.site/gcse/maths/ch06-standard-form-indices-surds/higher/index-notation-and-the-laws-of-indices/)

## Exercise 6A Powers and the laws of indices with numbers Non-calculator

**1** Write each product as a power.

(a)  $5 \times 5 \times 5 \times 5$

**Answer:**  $5^4$

(b)  $2 \times 2 \times 2 \times 2 \times 2 \times 2$

**Answer:**  $2^6$

(c)  $10 \times 10 \times 10$

**Answer:**  $10^3$

(d)  $7 \times 7$

**Answer:**  $7^2$

**2** Work out the value of each power.

(a)  $2^5$

**Answer:** 32

(b)  $3^4$

**Answer:** 81

(c)  $10^3$

**Answer:** 1000

(d)  $5^3$

**Answer:** 125

(e)  $4^3$

**Answer:** 64

(f)  $6^2$

**Answer:** 36

**3** Write each as a single power.

(a)  $2^3 \times 2^4$

**Answer:**  $2^7$

(b)  $5^2 \times 5^6$

**Answer:**  $5^8$

(c)  $7^5 \times 7^1$

**Answer:**  $7^6$

(d)  $10^3 \times 10^3$

**Answer:**  $10^6$

**4** Write each as a single power.

(a)  $6^8 \div 6^3$

**Answer:**  $6^5$

(b)  $4^9 \div 4^5$

**Answer:**  $4^4$

(c)  $3^7 \div 3^2$

**Answer:**  $3^5$

(d)  $10^6 \div 10^4$

**Answer:**  $10^2$

**5** Write each as a single power.

(a)  $(3^2)^4$

**Answer:**  $3^8$

(b)  $(5^3)^2$

**Answer:**  $5^6$

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

**Answer:**  $2^{15}$

(d)  $(10^2)^3$

**Answer:**  $10^6$

**6** Work out the **value** of each. Write it as a single power first.

(a)  $2^3 \times 2^2$

**Answer:** 32

(b)  $3^5 \div 3^3$

**Answer:** 9

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

**Answer:** 64

(d)  $10^2 \times 10^3$

**Answer:** 100,000

(e)  $5^4 \div 5^2$

**Answer:** 25

**7** Work out the value of each product.

(a)  $2^3 \times 5^2$

**Answer:** 200

(b)  $2^2 \times 3^3$

**Answer:** 108

(c)  $10^3 \times 4^2$

**Answer:** 16,000

(d)  $3^2 \times 2^4$

**Answer:** 144

**8** Find the missing index in each equation.

(a)  $3^4 \times 3^? = 3^9$

**Answer:** 5

(b)  $7^? \times 7^2 = 7^5$

**Answer:** 3

(c)  $5^8 \div 5^? = 5^3$

**Answer:** 5

(d)  $2^? \div 2^3 = 2^4$

**Answer:** 7

(e)  $(4^?)^3 = 4^{12}$

**Answer:** 4

**9** Write each as a single power of the base.

(a)  $\frac{5^7 \times 5^2}{5^6}$

**Answer:**  $5^3$

(b)  $\frac{2^3 \times 2^5}{2^4}$

**Answer:**  $2^4$

(c)  $\frac{3^9}{3^2 \times 3^3}$

**Answer:**  $3^4$

(d)  $\frac{7^4 \times 7^3}{7^2 \times 7^1}$

**Answer:**  $7^4$

- 10 Zoe says that  $2^3 \times 2^4$  is the same as  $4^7$ . Is she right? Explain your answer.

**Answer:** No.  $2^3 \times 2^4 = 2^7 = 128$ , but  $4^7 = 16,384$

- 11 Dan writes  $5^6 \div 5^2 = 5^3$ . Explain his mistake and write down the correct answer.

**Answer:** He divided the indices ( $6 \div 2 = 3$ ). They should be subtracted:  $5^4$ .

- 12 A piece of paper is folded in half again and again. Each fold doubles the number of layers.

- (a) How many layers are there after 6 folds? Write the answer as a power of 2 and then as a number.

**Answer:** 64

- (b) What is the smallest number of folds that gives more than 1000 layers?

**Answer:** 10

- 13 A message is sent in rounds. In round 1, one person sends it to 3 people. In every later round, each person who has just received it sends it to 3 new people. In round  $n$ ,  $3^n$  people receive the message.

- (a) How many people receive the message in round 5?

**Answer:** 243

- (b)

Show that the number of people in round 3 multiplied by the number in round 2 is the number in round 5.

**Answer:**  $27 \times 9 = 243$

- 14 A cube has edges of length  $10^2$  cm. The volume of a cube is (edge)<sup>3</sup>. Work out the volume as a number of  $\text{cm}^3$ .

**Answer:** 1,000,000  $\text{cm}^3$

- 15 Show that  $8 \times 16 = 2^7$ .

**Answer:**  $8 = 2^3$  and  $16 = 2^4$ , so  $8 \times 16 = 2^7 = 128$

- 16  $a$  and  $b$  are positive whole numbers.  $2^a \times 2^b = 2^8$  and  $2^a \div 2^b = 2^2$ . Find  $a$  and  $b$ .

**Answer:**  $a = 5$ ,  $b = 3$

## Exercise 6B The laws of indices with letters

Non-calculator

- 1 Simplify each expression.

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

**Answer:**  $x^7$

(b)  $y^5 \times y^2$

**Answer:**  $y^7$

(c)  $a \times a^6$

**Answer:**  $a^7$

(d)  $p^3 \times p^3$

**Answer:**  $p^6$

**2** Simplify each expression.

(a)  $x^9 \div x^4$

**Answer:**  $x^5$

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

**Answer:**  $y^5$

(c)  $m^8 \div m$

**Answer:**  $m^7$

(d)  $t^5 \div t^4$

**Answer:**  $t$

**3** Simplify each expression.

(a)  $(x^3)^2$

**Answer:**  $x^6$

(b)  $(y^4)^3$

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

(c)  $(a^2)^5$

**Answer:**  $a^{10}$

(d)  $(p^6)^2$

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

**4** Simplify each expression.

(a)  $3x^2 \times 4x^5$

**Answer:**  $12x^7$

(b)  $2y^3 \times 5y$

**Answer:**  $10y^4$

(c)  $6a^4 \times 2a^2$

**Answer:**  $12a^6$

(d)  $7p \times 3p^3$

**Answer:**  $21p^4$

**5** Simplify each expression.

(a)  $12y^8 \div 4y^3$

**Answer:**  $3y^5$

(b)  $20a^7 \div 5a^2$

**Answer:**  $4a^5$

(c)  $18x^5 \div 6x$

**Answer:**  $3x^4$

(d)  $8m^6 \div 2m^6$

**Answer:** 4

**6** Simplify each expression.

(a)  $(2a^3)^4$

**Answer:**  $16a^{12}$

(b)  $(5x^2)^3$

**Answer:**  $125x^6$

(c)  $(3y^4)^2$

**Answer:**  $9y^8$

(d)  $(10p^3)^2$

**Answer:**  $100p^6$

**7** Simplify each expression.

(a)  $3a^2b \times 5ab^3$

**Answer:**  $15a^3b^4$

(b)  $4x^2y \times 2xy^2$

**Answer:**  $8x^3y^3$

(c)  $6p^3q^2 \div 3pq$

**Answer:**  $2p^2q$

(d)  $10m^5n^4 \div 5m^2n$

**Answer:**  $2m^3n^3$

8 Mia writes  $2x^3 \times 3x^4 = 6x^{12}$ . Is she right? Give a reason.

**Answer:** No. It should be  $6x^7$ : the indices add ( $3 + 4 = 7$ ), they are not multiplied.

9 Is it true that  $x^3 + x^2 = x^5$ ? Use  $x = 2$  to explain.

**Answer:** No. When  $x = 2$ , the left side is 12 but the right side is 32.

10 A rectangle has length  $4x^3$  cm and width  $3x^2$  cm. Write an expression for its area in the simplest form.

**Answer:**  $12x^5 \text{ cm}^2$

11 The area of a rectangle is  $24x^7 \text{ cm}^2$ . Its length is  $6x^3$  cm. Find its width.

**Answer:**  $4x^4 \text{ cm}$

12 The three edges of a cuboid are  $2a$ ,  $3a^2$  and  $5a^3$ . Find an expression for its volume.

**Answer:**  $30a^6$

13 Simplify  $(2x^3y)^3 \times 4xy^2 \div 8x^2y$ .

**Answer:**  $4x^8y^4$

14 Simplify each expression.

(a)  $(3a^2b^3)^2 \div 9ab^2$

**Answer:**  $a^3b^4$

(b)  $(5m^2n)^3 \div 25mn^2$

**Answer:**  $5m^5n$

(c)  $4x^2 \times (2x^3)^2 \div 8x^5$

**Answer:**  $2x^3$

15 Simplify  $x^{n+2} \times x^{n-1}$ .

**Answer:**  $x^{2n+1}$

16  $2^x = k$ . Write  $2^{x+3}$  in terms of  $k$ .

**Answer:**  $8k$