

# C2.4 Indices II

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_ **Total: 20 marks**

**KEY WORDS** indices • equation • base • coefficient

## Objective

Use indices ii to solve Core IGCSE Mathematics problems.

**You must be able to:**

- Apply integer index laws to algebraic products and quotients
- Simplify coefficients separately from powers
- Find an unknown integer exponent by matching powers

## 1 Key knowledge and worked examples

### ■ Key knowledge: Indices II

Index rules apply to letters as well as numbers.  $a^m a^n = a^{m+n}$ ,  $a^m / a^n = a^{m-n}$  and  $(a^m)^n = a^{mn}$ . Raise a numerical coefficient to the outside power too. Nonzero values have zero power 1 and negative powers are reciprocals. To solve a simple index equation, express both sides with the same base; logarithms are not needed.

### ■ Worked example: Indices II

|                      |                    |                       |
|----------------------|--------------------|-----------------------|
| coefficient:<br>cube | index:<br>multiply | (3× squared)<br>cubed |
|----------------------|--------------------|-----------------------|

Simplify  $(3x^2)^3$ .

- Cube both factors:  $Q = 3^3(x^2)^3 = 27x^6$ .
- In division,  $12a^5/(3a^{-2}) = (12/3)a^{5-(-2)} = 4a^7$  for  $a \neq 0$ .
- Since  $2^5 = 32$ , the equation  $2^x = 32$  gives  $x = 5$ .

### ■ Method check

Apply a power to both the coefficient and each factor. Division subtracts indices, including when the divisor has a negative index.

## 2 Practice

**2.1** Simplify  $x^3x^4$ . [2]

**2.2** Simplify  $15a^6/(5a^2)$  for  $a \neq 0$ . [2]

**2.3** Simplify  $(2y^3)^2$ . [2]

**2.4** Solve  $3^n = 81$ . [2]

## 3 Exam-style questions

**3.1** Apply the indices ii methods below. Show working and include units where appropriate.

(a) Simplify  $4x^{-2} \times 3x^5$  for  $x \neq 0$ . [2]

(b) Divide your answer by  $6x$  and simplify. [2]

(c) Find the resulting value when  $x = -2$ . [2]

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**3.2** For  $x \neq 0$ , let  $E = (3x^2)^2/(9x^{-1})$ .

(a) Simplify E fully and calculate it when  $x = -2$ . [3]

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(b) Find the integer  $n$  for which  $2^{n+1} = 64$ . Explain why logarithms are unnecessary. [3]

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## Solutions

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Award method and answer marks as indicated; accept equivalent correct methods.

### 2.1

- Add powers:  $x^7$ .

### 2.2

- Divide coefficients and subtract indices:  $3a^4$ .

### 2.3

- Square both factors:  $4y^6$ .

### 2.4

- $81 = 3^4$ , so  $n = 4$ .

### 3.1

(a)

- $Q = (4 \times 3)x^{-2+5} = \mathbf{12x^3}$ .

(b)

- $R = 12x^3/(6x) = \mathbf{2x^2}$ .

(c)

- $R = 2(-2)^2 = 2(4) = \mathbf{8}$ .

### 3.2

(a)

- Numerator is  $9x^4$ , so  $E = x^{4-(-1)} = \mathbf{x^5}$ .
- At  $x = -2$ ,  $E = (-2)^5 = \mathbf{-32}$ .

(b)

- Rewrite  $64 = 2^6$ .
- Match exponents:  $n + 1 = 6$ , so  $n = \mathbf{5}$ .
- Both sides can be written with base 2.