

Exercise walk-through

C1.3

Powers and roots

IGCSE Mathematics

You must be able to

- Evaluate squares, cubes and their roots
- Distinguish a negative base from a negative sign outside a power
- Recover a positive length from an area or volume

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The method

Method — Key knowledge: Powers and roots

A power repeats multiplication, not addition. $a^2 = a \times a$ and $a^3 = a \times a \times a$. The square root is the nonnegative number whose square is the given value. A cube root can be negative. Learn squares from 1 to 15 and cubes of 1, 2, 3, 4, 5 and 10. Brackets decide whether a minus sign is part of the base.

Exercises 2.1·2.3

2.1 Find 12^2 and $\sqrt{225}$.

[2]

2.2 Find 5^3 and $\sqrt[3]{-27}$.

[2]

2.3 Calculate 3^4 and $\sqrt[4]{16}$.

[2]

Exercises 2.1·2.3

2.1 Find 12^2 and $\sqrt{225}$.

[2]

2.1

- $12^2 = 12 \times 12 = \mathbf{144}$; $15^2 = 225$, so $\sqrt{225} = \mathbf{15}$.

2.2 Find 5^3 and $\sqrt[3]{-27}$.

[2]

2.2

- $5^3 = 5 \times 5 \times 5 = \mathbf{125}$; $(-3)^3 = -27$, so the cube root is -3 .

2.3 Calculate 3^4 and $\sqrt[4]{16}$.

[2]

2.3

- Four factors give $3^4 = \mathbf{81}$. Since $2^4 = 16$, the positive fourth root is $\mathbf{2}$.

Exercise 2.4

2.4 Calculate $2^3 \times \sqrt{49}$.

[2]

3 Exam-style questions

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[2]

3 Exam-style questions

2.4

- Powers and roots first: $Q = 8 \times 7 = \mathbf{56}$.

Exercise 3.1 (a)

3.1 Apply the powers and roots methods below. Show working and include units where appropriate.

(a) A square has area 196 cm^2 . Find its side length.

[2]

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(a) A square has area 196 cm^2 . Find its side length. [2]

(a)

- $s^2 = A$, so $s = \sqrt{196} = \mathbf{14 \text{ cm}}$.

Exercise 3.1 (b)

3.1 Apply the powers and roots methods below. Show working and include units where appropriate.

(b) A cube has volume 1000 cm^3 . Find its edge length. [2]

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(b) A cube has volume 1000 cm^3 . Find its edge length. [2]

(b)

- $e^3 = V$, so $e = \sqrt[3]{1000} = \mathbf{10 \text{ cm}}$.

Exercise 3.1 (c)

3.1 Apply the powers and roots methods below. Show working and include units where appropriate.

(c) Find the sum of the square perimeter and the total length of the 12 cube edges. [2]

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(c) Find the sum of the square perimeter and the total length of the 12 cube edges. [2]

(c)

- $L = 4s + 12e = 4(14) + 12(10) = \mathbf{176}$ cm.

Exercise 3.2 (a)

3.2 A square tile has area 144 cm^2 . A cube has volume 216 cm^3 .

(a) Find the tile side and cube edge, stating which root is needed for each. [3]

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(a) Find the tile side and cube edge, stating which root is needed for each. [3]

(a)

- A square has $A = s^2$, so $s = \sqrt{A} = \sqrt{144} = \mathbf{12}$ cm.
- A cube has $V = e^3$, so $e = \sqrt[3]{216} = \mathbf{6}$ cm; square root for area, cube root for volume.

Exercise 3.2 (b)

3.2 A square tile has area 144 cm^2 . A cube has volume 216 cm^3 .

(b) A student claims that $(-4)^2 = -4^2$. Calculate both expressions and explain the role of the brackets. [3]

Exercise 3.2 (b)

3.2 A square tile has area 144 cm^2 . A cube has volume 216 cm^3 .

(b) A student claims that $(-4)^2 = -4^2$. Calculate both expressions and explain the role of the brackets. [3]

(b)

- $(-4)^2 = (-4)(-4) = \mathbf{16}$, while $-4^2 = -(4 \times 4) = -\mathbf{16}$.
- The brackets include the negative sign in the base; without them, the power is evaluated first.