E1.3 Powers and roots

Name: _____ Class: _____ Date: _____ **Total: 23 marks**

KEY WORDS power • powers and roots • cube root • square root • ratio

Objective

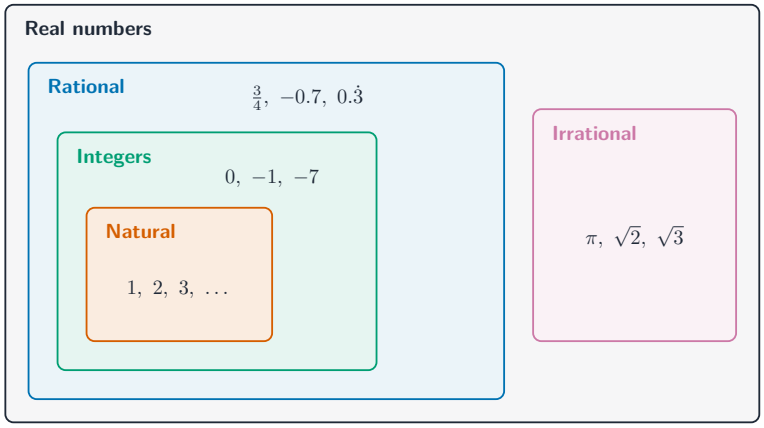
Build the skills to answer Extended exam questions on **powers and roots** – **squares, cubes**, and their roots, and evaluating expressions with powers and roots.

You must be able to:

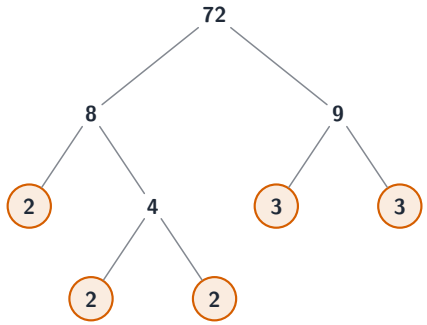
- recall squares to 15^2 and the cubes of 1–5 and 10
- find square roots and cube roots
- evaluate expressions combining powers and roots

1 Key knowledge and worked examples

Powers and roots



A power multiplies a number by itself; a root reverses it



$72 = 2^3 \times 3^2$

Prime factorisation underlies powers and roots

- **Power** : $2^5 = 32$. **Square root** : $\sqrt{169} = 13$. **Cube root** : $\sqrt[3]{8} = 2$.
- **Worked:** $5^2 \times \sqrt[3]{8} = 25 \times 2 = 50$.
- Recall squares (1–15) and cubes $(1, 2, 3, 4, 5, 10)$.

Answer shapes: **M1** a correct method, **A1** the correct answer.

2 Practice

2.1 Work out $\sqrt{196}$. [1]

2.2 Work out $\sqrt[3]{27} + 4^2$. [2]

2.3 Work out $\sqrt{144} - \sqrt[3]{64}$. [2]

3 Exam-style questions

3.1 Work out $3^3 - \sqrt{121}$. [2]

3.2 Work out $\sqrt{169} \times \sqrt[3]{125}$. [2]

3.3 Work out the value of $\sqrt{2^2 + 3^2 + 6^2}$. [2]

3.4 A cube has a volume of 2 197 cm^3.

(a) Find the length of one edge, and hence the total surface area of the cube. [4]

(b) A second cube has edges twice as long. Write down the ratio of the surface areas and the ratio of the volumes of the two cubes, and explain how you obtained them. [4]

(c) Without a calculator, show that $\sqrt[3]{\frac{64}{125}} \times \sqrt{\frac{81}{16}} = \frac{9}{5}$. [4]

Solutions

Marking: **M1** a correct method, **A1** the correct answer.

Each answer shows the steps, then the **result**.

2.1

- $\sqrt{196} = \mathbf{14}$

2.2

- $\sqrt[3]{27} = 3$ and $4^2 = 16$
- $3 + 16 = \mathbf{19}$

2.3

- $\sqrt{144} = 12$, $\sqrt[3]{64} = 4$
- $12 - 4 = \mathbf{8}$

3.1

- $3^3 = 27$, $\sqrt{121} = 11$
- $27 - 11 = \mathbf{16}$

3.2

- $\sqrt{169} = 13$, $\sqrt[3]{125} = 5$
- $13 \times 5 = \mathbf{65}$

3.3

- $2^2 + 3^2 + 6^2 = 4 + 9 + 36 = 49$
- $\sqrt{49} = \mathbf{7}$

3.4

(a)

- edge $= \sqrt[3]{2197} = \mathbf{13}$ cm
- surface area $= 6 \times 13^2 = 6 \times 169 = \mathbf{1014}$ cm$^{\mathbf{2}}$

(b)

- lengths $1 : 2$, so areas $1^2 : 2^2 = \mathbf{1} : \mathbf{4}$
- volumes $1^3 : 2^3 = \mathbf{1} : \mathbf{8}$
- area squares the length ratio; volume cubes it

(c)

- $\sqrt[3]{\dfrac{64}{125}} = \dfrac{4}{5}$
- $\sqrt{\dfrac{81}{16}} = \dfrac{9}{4}$

$$\frac{4}{5} \times \frac{9}{4} = \mathbf{\frac{9}{5}}$$