E1.7 Indices I

Name: _____ Class: _____ Date: _____ **Total: 22 marks**

KEY WORDS indices • laws of indices • factor • power • prime factor

Objective

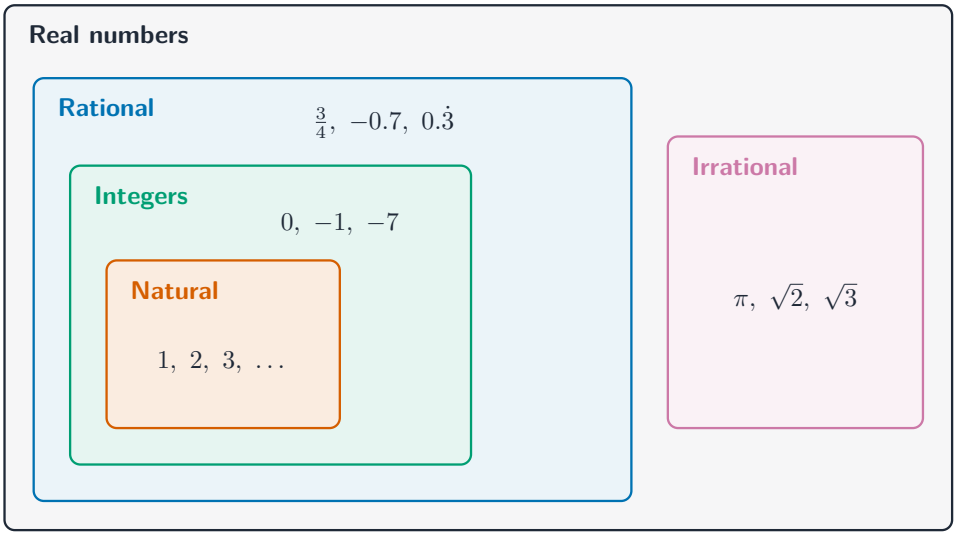
Build the skills to answer Extended exam questions on **indices** – the **laws of indices**, and **zero, negative and fractional** powers.

You must be able to:

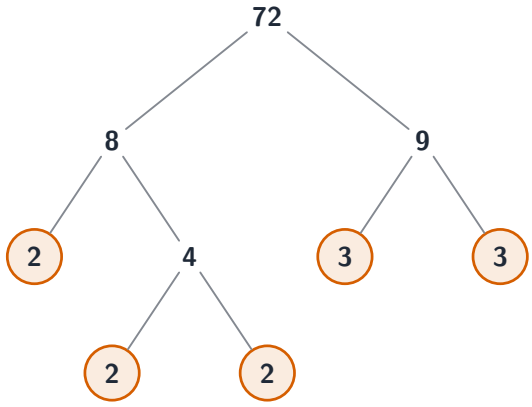
- use $a^m \times a^n = a^{m+n}$, $a^m \div a^n = a^{m-n}$, $(a^m)^n = a^{mn}$
- evaluate a^0, a^{-n} and $a^{\frac{m}{n}}$
- simplify expressions with indices

1 Key knowledge and worked examples

Laws of indices



Add powers to multiply; subtract to divide



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

Indices appear when a number is written in prime factors

$$a^m \times a^n = a^{m+n} \qquad a^m \div a^n = a^{m-n} \qquad (a^m)^n = a^{mn}$$

$$a^0 = 1 \qquad a^{-n} = \frac{1}{a^n} \qquad a^{\frac{m}{n}} = \left(\sqrt[n]{a}\right)^m$$

- **Worked:** $2^{-3} \times 2^4 = 2^1 = 2$; $(2^3)^2 = 2^6 = 64$; $8^{-\frac{2}{3}} = \frac{1}{(\sqrt[3]{8})^2} = \frac{1}{4}$.

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

2 Practice

2.1 Simplify $x^5 \times x^3$. [1]

2.2 Work out the value of 2^{-3}. [1]

2.3 Work out the value of $81^{\frac{1}{2}}$. [1]

3 Exam-style questions

3.1 Simplify $(2a^2)^3$. [2]

3.2 Work out the value of $27^{\frac{2}{3}}$. [2]

3.3 Work out the value of $16^{-\frac{1}{2}}$. [2]

3.4 (a) Simplify, leaving your answers in index form: [4]

(i) $\dfrac{x^7 \times x^{-3}}{x^2}$ (ii) $(2y^3)^4$

(b) Evaluate without a calculator, showing each step: [4]

(i) $27^{\frac{2}{3}}$ (ii) $\left(\dfrac{25}{4}\right)^{-\frac{1}{2}}$

(c) Solve $2^{x+1} = \dfrac{1}{32}$. [3]

(d) Explain, using the laws of indices, why $a^0 = 1$ for any non-zero a. [2]