The Panda Math Tutor

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Powers and Roots

Solutions & Answer Key

Full worked solutions, marking scheme & answer key

IGCSE Mathematics

The Panda Math Tutor

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Companion to the *Student Worksheet*

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Note

About this booklet. These are the complete solutions to every question in the *Powers and Roots — Student Worksheet*. Question numbers match exactly: powers P1–P6, laws of indices L1–L11, roots R1–R6, fractional indices F1–F7, combined problems C1–C4, index equations Q1–Q5, standard form S1–S7, surds D1–D7, applications A1–A5, the Mixed Review MR1–MR10, and the examination questions Q1–Q8 of Part III.
Each solution names the law being applied and works one step at a time. Part V collects the common mistakes to watch for, and Part VI is a quick answer key for fast marking.

4 Part IV — Complete Solutions

Note

Each solution names the law being applied and shows the steps in order, exactly as the notes recommend. Depth is scaled to difficulty — brief for basic questions, fuller for the harder ones.

4.1 Solutions — Powers (Indices)

Solution P1

(a) $2^6 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = \boxed{64}$
(b) $5^3 = 5 \times 5 \times 5 = \boxed{125}$
(c) $10^4 = \boxed{10\,000}$ (a 1 followed by four zeros)

Solution P2

The number 8 is multiplied by itself five times, so

$$8 \times 8 \times 8 \times 8 \times 8 = \boxed{8^5}.$$

The **base** is 8 and the **index** is 5. (Its value is 32 768.)

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Solution P3

(a) 3 appears twice and 7 appears three times:

$$3 \times 3 \times 7 \times 7 \times 7 = \boxed{3^2 \times 7^3}.$$

(b) 2 appears four times, 5 once and 11 twice:

$$\boxed{2^4 \times 5 \times 11^2}.$$

Solution P4

(a) The base -2 is raised to an *odd* power, so the answer is negative:

$$(-2)^5 = \boxed{-32}.$$

(b) The base -4 is raised to an *even* power, so the answer is positive:

$$(-4)^4 = \boxed{256}.$$

Solution P5

$$-2^6 = -(2^6) = -64, \qquad (-2)^6 = (-2) \times (-2) \times \cdots \times (-2) = +64.$$

Why they differ: in -2^6 there are no brackets, so the index applies *only to the* 2 and the minus sign is applied afterwards. In $(-2)^6$ the brackets mean the whole of -2 is raised to the power, and since the index is even the negatives cancel in pairs.

$$\boxed{-2^6 = -64 \quad \text{and} \quad (-2)^6 = 64}$$

Common Mistake

The position of the bracket changes the answer completely. Always check whether the minus sign is inside or outside.

Solution P6

(a) $(-7)^9$: negative base, *odd* power $\Rightarrow$ $\boxed{\text{negative}}$.
(b) $(-5)^{12}$: negative base, *even* power $\Rightarrow$ $\boxed{\text{positive}}$.
(c) -9^4: the index applies only to 9, giving a positive value, and the minus is applied last $\Rightarrow$ $\boxed{\text{negative}}$.

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