JUNIOR CYCLE MATHS · FREE REVISION SHEET

Indices & standard form

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Learning outcomes (2018 specification): N.1c, N.1f. Play the game: **leim.ie/power-up.html**

1. Index notation

In 2^5, 2 is the **base** and 5 is the **index**: $2^5 = 2 \times 2 \times 2 \times 2 \times 2 =$ **32** (not 10).

$10^6 = 1{,}000{,}000$ (6 zeros). $(-3)^2 = 9$ but $-3^2 = -9$: the index only belongs to what it touches.

2. Square roots

$\sqrt{49} = 7$ because $7^2 = 49$. $49^{½} = \sqrt{49}$. $\sqrt{50}$ is between 7 and 8 ($7^2 = 49$, $8^2 = 64$). $\sqrt{(36 + 64)} = \sqrt{100} = 10$, not $6 + 8$.

3. BIMDAS

Brackets, Indices, ÷ ×, + −

$5 + 3^2 \times 2$ $= 5 + 9 \times 2 = 5 + 18 = 23$

$4 \times 2^3 = 4 \times 8 = 32$ (not 8^3)

4. Standard form

$a \times 10^n$ with $1 \le a < 10$ and n a whole number.

45,000 → 4.5 (the point moved 4 places) → **4.5×10^4**

3.07×10^5 → move the point 5 right → 307,000

Not standard form: 45×10^3, 0.45×10^5. Compare the powers of 10 first.

5. The laws of indices

$a^p \times a^q = a^{p+q}$	$a^p \div a^q = a^{p-q}$	$(a^p)^q = a^{pq}$
add	subtract	multiply

$x^3 \times x^5 = x^8 \cdot 5^9 \div 5^3 = 5^6 \cdot (2^3)^4 = 2^{12}$. The base stays the same: $2^3 \times 2^4 = 2^7$, not 4^7.

Numbers in front: $3x^2 \times 4x^5 = 12x^7 \cdot 12x^7 \div 3x^2 = 4x^5$. $x^3 + x^4$ can't be joined.

Find n: $2^n \times 2^3 = 2^{10} \rightarrow n + 3 = 10 \rightarrow n = 7$.

6. Calculating in standard form

$(4 \times 10^3) \times (5 \times 10^2) = 20 \times 10^5 =$ **2×10^6**

$(8 \times 10^9) \div (2 \times 10^3) =$ **4×10^6**

numbers first, then the indices, then tidy up

7. Zero, negative & fractional Higher Level

$a^0 = 1 \cdot 2^{-3} = 1/2^3 = 1/8$ (not negative) $\cdot 8^{1/3} = 2 \cdot 27^{2/3} = 3^2 = 9$ (root first) $\cdot (2x^3)^2 = 4x^6 \cdot 2^x = 1/8 = 2^{-3}$, so $x = -3 \cdot 0.00036 = 3.6 \times 10^{-4}$

Exam tip: write the law you used ($2^5 \times 2^3 = 2^{5+3} = 2^8$), give the answer in the form asked for ("as a power of 2", "in standard form"), and copy calculator answers in standard form properly with × 10 and the index.

PRACTICE · 34 QUESTIONS

Have a go

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A. Powers and roots

1. Work out 2^6 _____
2. Work out 3^4 _____
3. Work out $(-3)^2$ _____
4. Work out -3^2 _____
5. Work out $(-2)^5$ _____
6. Work out $\sqrt{121}$ _____
7. Write 1,000,000 as a power of 10.
   _____
8. $\sqrt{50}$ lies between which two whole numbers? _____

B. BIMDAS and the laws

9. Work out $4 + 3^2 \times 2$ _____
10. Work out $(4 + 3)^2$ _____
11. Work out 2×5^3 _____
12. Work out $\sqrt{(10^2 - 6^2)}$ _____
13. Simplify $x^4 \times x^5$ _____
14. Work out $7^8 \div 7^3$ _____
15. Simplify $(a^3)^4$ _____
16. Simplify $3x^2 \times 5x^4$ _____

C. More laws, find n

17. Simplify $20y^9 \div 4y^3$ _____
18. Simplify $2a^2b \times 3ab^4$ _____
19. $(2^4 \times 2^5) \div 2^7$ (give the value) _____
20. $5^7 \div 5^4$ (give the value) _____
21. Find n: $2^n \times 2^4 = 2^{11}$ _____
22. Find n: $(3^n)^2 = 3^{10}$ _____
23. Find n: $4^n = 64$ _____
24. True or false? $2^3 \times 2^4 = 4^7$. Explain.
    _____

D. Standard form

25. Write 6,400 in standard form. _____
26. Write 2,050,000 in standard form.
    _____
27. Write 3.2×10^4 as an ordinary number.
    _____
28. Put in order, smallest first: 4.1×10^5, 9.9×10^4, 1.2×10^6. _____
29. Work out $(5 \times 10^3) \times (4 \times 10^2)$. Give your answer in standard form. _____
30. Work out $(6 \times 10^8) \div (2 \times 10^3)$. Give your answer in standard form. _____

Questions 31–34 are on the next page.

EXAM-STYLE · THEN CHECK

Exam corner + answers

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E. Exam-style questions (show your work)

31. **Higher Level.** Work out (a) $16^{3/4}$ (b) 5^{-2} (c) 7^{0}. (d) Solve $3^{x} = 1/9$.

32. The Moon is about 384,000 km from the Earth. (a) Write this in standard form. (b) A spacecraft travels at 1.6×10^{4} km per hour. How many hours does it take to reach the Moon?

33. A cube has edges 2^{4} cm long. (a) Write its volume as a power of 2. (b) Work out the volume. (c) Each face has area $(2^{4})^{2}$ cm^{2}. Write the total surface area as 6 × a power of 2, then work it out.

34. **Higher Level.** (a) Simplify $(3x^{2})^{3} \div x^{4}$. (b) Write 0.000075 in standard form. (c) Work out $(5 \times 10^{-3}) \times (4 \times 10^{-2})$ in standard form.

Answers

A	1. 64 · 2. 81 · 3. 9 · 4. −9 · 5. −32 · 6. 11 · 7. 10^{6} · 8. 7 and 8
B	9. 22 · 10. 49 · 11. 250 · 12. 8 · 13. x^{9} · 14. 7^{5} · 15. a^{12} · 16. $15x^{6}$
C	17. $5y^{6}$ · 18. $6a^{3}b^{5}$ · 19. 4 · 20. 125 · 21. 7 · 22. 5 · 23. 3 · 24. False: the base stays 2, so 2^{7}
D	25. 6.4×10^{3} · 26. 2.05×10^{6} · 27. 32,000 · 28. 9.9×10^{4}, 4.1×10^{5}, 1.2×10^{6} · 29. 2×10^{6} · 30. 3×10^{5}
E	31. (a) fourth root of 16 = 2, 2^{3} = **8** (b) $1/5^{2}$ = **1/25** (c) **1** (d) $1/9 = 3^{-2}$, so **$x = -2$** · 32. (a) **3.84×10^{5} km** (b) $(3.84 \times 10^{5}) \div (1.6 \times 10^{4}) = 2.4 \times 10^{1}$ = **24 hours** · 33. (a) $(2^{4})^{3}$ = **2^{12} cm^{3}** (b) **4,096 cm^{3}** (c) 6×2^{8} = **1,536 cm^{2}** · 34. (a) $27x^{6} \div x^{4}$ = **$27x^{2}$** (b) **7.5×10^{-5}** (c) 20×10^{-5} = **2×10^{-4}**

Got one wrong? Did you multiply the base by the index ($2^{5} = 10$)? Add the indices when multiplying, subtract when dividing, multiply for a power of a power, and keep the base the same. Do indices before × and +. In standard form, the front number must be between 1 and 10. Then play **Power Up** at leim.ie/power-up.html: the "Go back over these" list at the end shows the rule for each mistake.

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