



Integer exponents

GRADE 8 MATH

Answer keys for the exit ticket, practice worksheet, and homework, plus notes for the lesson slides. Each answer shows the steps and the most likely wrong answer ("If wrong"), so you can tell what a mistake means, not just that it is one. Questions go from **fluency** to **application** to **reasoning**.

Exit Ticket — answer key

Use: End of the exponents lesson. 5–8 min, independent. Item 2 is the diagnostic: identical answers to the two expressions means the add/multiply laws are being swapped, and a child can still reach 2^6 by chance, so mark the explanation.

Timing: 5–8 min · independent. No calculator.

1. $5^2 \times 5^4$ **FLUENCY**

Answer: 5^6

1. Multiplying powers of the same base, so ADD: $2 + 4 = 6$.
2. 5^6 . (Writing it out: two fives times four fives is six fives.)

If wrong: Answered 5^8 by multiplying the exponents, which is the powering law used in the wrong place. Or 25^6 , multiplying the bases as well.

2. $(2^3)^2$ **REASONING**

Answer: 2^6 , whereas $2^3 \times 2^2 = 2^5$

1. $(2^3)^2$ means $2^3 \times 2^3$ — two lots of three factors, so six factors: $2^6 = 64$.
2. $2^3 \times 2^2$ is three factors and two factors, so five: $2^5 = 32$.
3. One is a power OF a power (multiply the exponents); the other is a product of powers (add them).
4. Writing the factors out settles which is which every time.

If wrong: Gave the same answer to both, which is the swap this whole sheet is about. Read the explanation rather than the two values — a child can land on 2^6 by luck.

3. 4^0 and 3^{-2} FLUENCY

Answer: **1 and $\frac{1}{9}$**

1. $4^0 = 1$. Any non-zero base to the power 0 is 1.

2. $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$.

If wrong: Answered $4^0 = 0$, reading zero as nothing; or $3^{-2} = -9$ or -6 .

4. Correct Leo REASONING

Answer: **$\frac{1}{8}$ — the minus means reciprocal**

1. A negative exponent does not make the answer negative. It flips it.

2. $2^{-3} = \frac{1}{2^3} = \frac{1}{8}$.

3. Why: $2^5 \div 2^8 = 2^{-3}$ by the division law, and it is also $\frac{1}{2^3}$ by cancelling. Both must be the same thing.

4. Leo has read the minus as a sign on the answer rather than as an instruction.

If wrong: Agreed, or gave $\frac{1}{8}$ without saying what the minus actually does. The instruction-versus-sign distinction is the diagnosis.

Quick answers for fast checking:

#	Level	Answer
1	fluency	5^6
2	reasoning	2^6 against 2^5
3	fluency	1 and $\frac{1}{9}$
4	reasoning	$\frac{1}{8}$

Practice Worksheet — answer key

Use: In-class practice after the deck. Item 8 is the most valuable: it applies a real law outside its conditions, which is where confident wrong answers come from for the rest of algebra. Item 2 is the swap diagnostic, built from the same two numbers so only the law distinguishes them.

Timing: 15–20 min · pairs · no calculators · items 4 and 8 on the board.

1. 3^4 **FLUENCY**

Answer: $3 \times 3 \times 3 \times 3 = 81$

1. Four factors of 3.
2. 9, 27, 81.

If wrong: Answered 12 by multiplying 3 by 4.

2. $7^3 \times 7^5$ and $(7^3)^5$ **FLUENCY**

Answer: 7^8 and 7^{15}

1. Product: add, $3 + 5 = 8$.
2. Power of a power: multiply, $3 \times 5 = 15$.

If wrong: Gave the same answer twice. The pair is deliberately built from the same two numbers so only the law distinguishes them.

3. $2^7 \div 2^4$ **FLUENCY**

Answer: $2^3 = 8$

1. Dividing subtracts: $7 - 4 = 3$.

If wrong: Divided the exponents to get $2^{1.75}$.

4. Why $9^0 = 1$ **REASONING**

Answer: **an argument that $9^2 \div 9^2$ is 1 by cancelling and 9^0 by the division law, so the two must agree**

1. $9^2 \div 9^2 = 81 \div 81 = 1$.
2. The division law says it is $9^{2-2} = 9^0$.
3. Both describe the same calculation, so $9^0 = 1$.
4. It is forced by the law, not a separate rule to memorise.

If wrong: Said “because that is the rule”. The derivation is the item; the rule is what they already had.

5. 5^{-2} and 10^{-3} APPLICATION

Answer: $\sqrt[5]{2^5}$ and $\sqrt[10]{1000}$

1. $5^{-2} = \sqrt[5]{5^2} = \sqrt[5]{2^5}$.

2. $10^{-3} = \sqrt[10]{1000} = 0.001$.

If wrong: Answered -25 and -1000 .

6. $4^2 \div 4^5$ APPLICATION

Answer: $4^{-3} = \sqrt[4]{64}$

1. Subtract: $2 - 5 = -3$, so 4^{-3} .

2. As a fraction: $\sqrt[4]{4^3} = \sqrt[4]{64}$.

3. Check by cancelling: $16 \div 1024 = \sqrt[4]{64}$.

If wrong: Subtracted the other way to get 4^3 . The order matters, and the cancelling check catches it.

7. $(-2)^4$ and $(-2)^3$ REASONING

Answer: **16 and -8 — even powers pair the minuses up**

1. $(-2)^4 = 16$: four negatives make two pairs, and each pair cancels.

2. $(-2)^3 = -8$: three negatives leave one over.

3. Even exponent, positive result. Odd exponent, negative result.

If wrong: Gave both positive, or both negative. This is the same pairing argument as square versus cube roots and worth naming as such.

8. Is $2^3 \times 3^3 = 6^6$? REASONING

Answer: **no — it is $6^3 = 216$**

1. The add-the-exponents law needs the SAME base. Here the bases differ.

2. $2^3 \times 3^3 = 8 \times 27 = 216$.

3. And $6^3 = 216$, so the powers combine over the bases: $2^3 \times 3^3 = (2 \times 3)^3$.

4. $6^6 = 46656$, which is far too big.

If wrong: Answered yes. Evaluating both sides settles it instantly and is worth insisting on — a law applied outside its conditions is the commonest source of confident wrong answers in algebra.

9. $(2^2 \times 2^3)^2$ APPLICATIONAnswer: $2^1_0 = 1024$

1. Inside first: $2^2 \times 2^3 = 2^5$.
2. Then the outer power: $(2^5)^2 = 2^1_0$.
3. Both laws, in order.

If wrong: Applied one law and stopped, giving 2^5 or 2^6 . This item needs both and is the reason it is last.

Quick answers for fast checking:

#	Level	Answer
1	fluency	81
2	fluency	7^8 and 7_1^5
3	fluency	$2^3 = 8$
4	reasoning	forced by the division law
5	application	$\sqrt[2]{2^5}$ and $\sqrt[4]{1000}$
6	application	$\sqrt[4]{64}$
7	reasoning	16 and -8
8	reasoning	no $- 6^3$
9	application	2^1_0

Homework — answer key

Use: Homework after the practice sheet. Item 8 depends on noticing that a bare 3 is 3^1 , which is the quiet prerequisite for every later index manipulation.

Timing: 20–25 min · independent · no calculator · items 5 and 7 first when marking.

1. $6^2 \times 6^5$ FLUENCYAnswer: 6^7

1. Add: $2 + 5 = 7$.

If wrong: Answered 6^1_0 .

2. $(5^2)^4$ FLUENCY

Answer: 5^8

1. Multiply: $2 \times 4 = 8$.

If wrong: Answered 5^6 .

3. 8^0 and 2^{-4} FLUENCY

Answer: 1 and $\frac{1}{16}$

1. $8^0 = 1$.

2. $2^{-4} = \frac{1}{2^4} = \frac{1}{16}$.

If wrong: Answered 0 and -16 — both of the classic misreadings in one item.

4. $3^6 \div 3^2$ FLUENCY

Answer: $3^4 = 81$

1. Subtract: $6 - 2 = 4$.

If wrong: Answered 3^3 .

5. $4^2 \times 4^3$ against $(4^2)^3$ REASONING

Answer: 4^5 and 4^6

1. The product is five factors of 4: $4^5 = 1024$.

2. The power of a power is three lots of two factors: $4^6 = 4096$.

3. Products add the exponents; powers of powers multiply them.

If wrong: Said they are equal. Writing out the factors is the check that always works and needs no memory.

6. $5^3 \div 5^6$ APPLICATION

Answer: $5^{-3} = \frac{1}{5^3}$

1. $3 - 6 = -3$, so 5^{-3} .

2. $= \frac{1}{5^3} = \frac{1}{125}$.

If wrong: Answered 5^3 , subtracting the wrong way round.

7. Why 7^0 is not 0 REASONING

Answer: **because $7^2 \div 7^2 = 1$, and the law makes that 7^0**

1. Any non-zero number divided by itself is 1.
2. The division law turns $7^2 \div 7^2$ into 7^0 .
3. So $7^0 = 1$. Reading the zero as 'nothing' confuses the exponent with a coefficient: 0×7 is nothing, but 7^0 is not.

If wrong: Restated that the rule says 1. The item asks WHY, and the coefficient-versus-exponent confusion is the thing to name.

8. $(3^3 \div 3)^2$ APPLICATION

Answer: **$3^4 = 81$**

1. Inside: $3^3 \div 3^1 = 3^2$.
2. Then square it: $(3^2)^2 = 3^4 = 81$.
3. The bare 3 is 3^1 — the exponent 1 is invisible but present.

If wrong: Treated the bare 3 as having no exponent and got 3^6 . The invisible 1 is what this item is for.

Quick answers for fast checking:

#	Level	Answer
1	fluency	6^7
2	fluency	5^8
3	fluency	1 and $\sqrt[4]{16}$
4	fluency	3^4
5	reasoning	4^5 and 4^6
6	application	$\sqrt[4]{1^{25}}$
7	reasoning	forced by the division law
8	application	3^4

Lesson slides — teaching notes & timing

Mini-lesson slides, then the practice worksheet. Slide numbers match the deck.

Slide	~Time	Note
1/8	0:00	Name the confusion up front. Most of the class can state both laws and cannot reliably say which applies to which.
2/8	1:00	$2^3 = 6$ first, because it is the foundation error and it is quick to kill.

3/8	2:00	Derive the multiplying law by writing out the factors. Do NOT state it and drill it — the derivation is what lets a child rebuild it when they forget.
4/8	3:30	Now the powering law, the same way. The parallel structure is the point: both are just counting factors, and neither has to be memorised in isolation.
5/8	5:00	Dividing. Quick — cancelling makes it obvious.
6/8	6:00	THE slide for x^0 . Children resent this rule until they see it is forced by the division law rather than declared by a textbook.
7/8	7:30	Negative exponents. Say “flip” every time and never “minus”. $2^{-2} = -4$ is the second commonest error on the topic.
8/8	9:00	Four to try, then the exit ticket. The question to keep asking is which operation is happening — that is the whole skill.