



Place value and powers of ten

GRADE 5 MATH

Answer keys for the exit ticket and practice worksheet, 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 powers-of-ten lesson. Item 3 is the diagnostic and the answer wanted is specific: the zero in 340 RECORDS AN EMPTY ONES PLACE, and 2.7 has a 7 to put there. “It only works for whole numbers” is a true boundary that leaves the child with two rules and no reason, so it will not survive the next unfamiliar case. This is the “shortcuts that score full marks and teach nothing” thread and it is the worst-timed appearance of the four — underline-a-digit rounding (the “Rounding multi-digit numbers” sheet (Grade 4)) fails when a child is asked to justify, but “add a zero” fails on the first decimal, after two years of full marks. Item 2 catches the decimal-point belief, which is invisible in item 1 because it produces correct answers: a child who says the point moves gets 27 and cannot say what happened to the 7. Item 4 is the symmetry, and the rightward half is genuinely new — the “Ten times the place to its right” sheet (Grade 4) taught only the leftward one.

Timing: 5–8 min · independent · place-value charts available.

1. One place left **FLUENCY**

Answer: **6**

1. The 6 moves from tenths to ones, giving 6.

If wrong: Answered 0.60 — the same amount as 0.6, so nothing was multiplied.

2. A power of ten as an exponent **FLUENCY**

Answer: **270**

1. 10^2 is two places left.
2. The 2 goes to hundreds and the 7 to tens — 270.

If wrong: Answered 2.700 — zeros added rather than digits moved; or 27, reading the exponent as one place.

3. Three places right FLUENCY

Answer: **0.45**

1. 10^3 is three places right.
2. The 4 goes from hundreds to tenths and the 5 to hundredths — 0.45.

If wrong: Answered 450 unchanged, or 0.450. Every wrong answer here is the same amount as the number started with, which is the give-away.

4. The 2 and the 7 APPLICATION

Answer: **the 2 moves from ones to tens, so it is worth 20; the 7 moves from tenths to ones, so it is worth 7 — giving 27**

1. Multiplying by 10 moves every digit one place left.
2. The 2 was in the ones place, worth 2; it lands in the tens, worth 20.
3. The 7 was in the tenths place, worth seven tenths; it lands in the ones, worth 7.
4. $20 + 7 = 27$. The decimal point did not move — the digits moved past it.

If wrong: Said “the decimal point moves one place right”. That gets 27 and describes the wrong thing as moving, so it cannot answer what happened to the 7 — which is what the standard asks for.

5. Priya's rule REASONING

Answer: **because for 34 the digits moving left leave the ones place empty and the 0 records it, while 2.7 has a 7 to fill the ones place, so no zero is needed and adding one changes nothing**

1. In 34×10 the 3 goes to hundreds and the 4 to tens. Nothing is left in the ones, so a 0 is written there: 340.
2. The zero was the SYMPTOM of an empty place, not the operation.
3. In 2.7×10 the 7 moves into the ones place, so the ones place is not empty and needs no 0.
4. Adding a zero on the end of 2.7 gives 2.70, which is seven tenths still — the same number, so nothing was multiplied at all.

If wrong: Said “the rule only works for whole numbers”. True and it is a boundary rather than a reason; what makes the next case answerable is knowing WHY the zero appeared — an empty ones place — and 2.7 does not have one.

6. Both directions REASONING

Answer: **each place to the LEFT is worth ten times as much, and each place to the RIGHT is worth one tenth as much — so 700, 70 and 0.7 are the same digit three places apart**

1. From 0.7 to 7 to 70 to 700, each step left multiplies the digit's value by 10.
2. Going the other way, each step right divides it by 10: 700, 70, 7, 0.7.
3. The two statements are the same rule read in opposite directions, which is why it is one system and not two.
4. So the value of a digit depends entirely on its place, and 700 is 1000 times seven tenths.

If wrong: Described only the leftward direction, which is what Grade 4 taught in the “Ten times the place to its right” sheet (Grade 4). The rightward half — one tenth as much — is the new part this year, and it is what makes decimals part of the same system rather than a separate topic.

Quick answers for fast checking:

#	Level	Answer
1	fluency	6
2	fluency	270
3	fluency	0.45
4	application	2: ones to tens; 7: tenths to ones; 27
5	reasoning	the 0 records an empty ones place; 2.7's 7 fills it
6	reasoning	ten times left, one tenth right — one rule both ways

Practice Worksheet — answer key

Use: In-class practice after the deck. Item 9 is the most valuable item on the sheet and it is not about place value at all — it asks why a wrong method survived two years, and the answer is that it never disagreed with the right one on any example a child was given. That is worth saying explicitly to a Grade 5 class, because it is the general shape of this thread: underline-a-digit rounding (the “Rounding multi-digit numbers” sheet (Grade 4)), “multiply the digits and add a zero” (G3 NBT-03) and length-times-width without tiling (G3 MD-06) all survive the same way. Item 6 is where the off-by-one thread appears in place value: four place NAMES, three STEPS between them, and a factor of 1000. A child who answers “four places, 1000 times” has counted the names rather than the gaps — the same error as counting tick marks instead of jumps (G2 MD-04) — and it is self-detecting, because four steps of $\times 10$ would be 10000. Item 2's third part is the sharpest fluency item here: with no visible zero to remove, the shortcut has nothing to do.

Timing: 15–20 min · pairs · place-value charts · items 6, 8 and 9 on the board.

1. One place left FLUENCY

Answer: **34**

1. The 3 moves to tens and the 4 to ones — 34.

If wrong: Answered 3.40 — the same amount as 3.4, so nothing was multiplied at all. A zero was appended instead of the digits moving.

2. Two places left FLUENCY

Answer: **340**

1. The 3 goes to hundreds and the 4 to tens — 340.
2. The 0 is an empty ones place the digits have vacated, not an appended symbol.

If wrong: Answered 3.400 — again unchanged in value.

3. Three places left FLUENCY

Answer: **3400**

1. Three places: 3400.
2. Both zeros are places the digits have vacated.

If wrong: Answered 3.4000 — unchanged. All three wrong answers come from one belief: that multiplying by ten means writing a zero somewhere.

4. One place right FLUENCY

Answer: **6.2**

1. The 6 moves from tens to ones and the 2 from ones to tenths — 6.2.

If wrong: Answered 62.0 or 6.20 — a zero moved rather than the digits. Both are the same amount as the number started with or ten times off.

5. Two places right FLUENCY

Answer: **0.62**

1. The 6 goes to tenths and the 2 to hundredths — 0.62.
2. The 0 before the point holds the ones place when nothing is there.

If wrong: Answered 0.62 correctly but by “removing zeros”, a rule that runs out at the next item.

6. Three places right **FLUENCY**

Answer: **0.062**

1. The 6 goes to hundredths and the 2 to thousandths — 0.062.
2. THIS IS THE ONE THAT BREAKS THE ZERO RULE: there is no visible zero left to remove, so only tracking the digits works.

If wrong: Answered 0.62 — unchanged from the previous item, because there was no zero left to take away. Tracking the digits gives 0.062.

7. Powers of ten written out **FLUENCY**

Answer: **10, 100, 1000, 10000 — the exponent equals the number of zeros**

1. $10^1 = 10$, one zero. $10^2 = 100$, two zeros. $10^3 = 1000$, three. $10^4 = 10000$, four.
2. The exponent counts how many tens are multiplied, and each ten contributes one zero.
3. It is also the number of places every digit moves when you multiply by it.

If wrong: Wrote 10, 20, 30, 40 — the exponent read as a multiplier. Item 4 is where that gets examined.

8. Ben's 10^3 **REASONING**

Answer: **he multiplied 3 by 10; 10^3 means three tens multiplied, which is 1000, and his method would give 0 for 10^0 when the answer is 1**

1. 10^3 means $10 \times 10 \times 10 = 1000$.
2. Ben has worked out $3 \times 10 = 30$, reading the small 3 as something to multiply BY rather than a count of tens.
3. His answer is out by a factor of more than 30.
4. And 10^0 would be $0 \times 10 = 0$ on his method, while 10^0 is 1 — so the wrong reading cannot even produce a sensible answer there.

If wrong: Corrected the 30 to 1000 without addressing 10^0 . The 10^0 case is the useful half: it shows the two readings are not just numerically different but that one of them cannot be extended at all.

9. 450, 45, 4.5, 0.45 **REASONING**

Answer: **the digits 4 and 5 are the same and in the same order in all four; what differs is which places they sit in, so each number is a tenth of the one above**

1. Every one of them is written with a 4 then a 5.
2. In 450 the 4 is in the hundreds; in 45 the tens; in 4.5 the ones; in 0.45 the tenths.
3. Each step down moves both digits one place right, which divides by 10.
4. So the four numbers are 450, 45, 4.5, 0.45 — the same digits, worth a tenth as much each time.

If wrong: Said “the decimal point is in a different place”. That describes the writing rather than the value, and it will not answer item 6 — the question is what the DIGITS are worth.

10. 800 and 0.8 **APPLICATION**

Answer: **three places apart, and the first is 1000 times bigger**

1. 800 has the 8 in the hundreds place; 0.8 has it in the tenths.
2. Count the STEPS, not the place names: hundreds to tens is one, tens to ones is two, ones to tenths is three.
3. Four place names are involved and there are three steps between them, which is why counting names gives one too many.
4. Each step multiplies by 10, so the values differ by $10 \times 10 \times 10 = 1000$.
5. Check: $0.8 \times 1000 = 800$.

If wrong: Answered “four places apart, 1000 times bigger” — the factor right and the distance one too many, because the four place NAMES were counted instead of the three steps between them. This is the off-by-one thread in place value: the same error as counting tick marks instead of jumps (G2 MD-04) or lines instead of spaces (G2 G-02), and it is self-detecting here, since three steps of $\times 10$ is 1000 and four would be 10000.

11. Multiply then divide by 1000 APPLICATION

Answer: **2700, then back to 2.7**

1. 2.7×1000 : three places left, giving 2700.
2. $2700 \div 1000$: three places right, giving 2.7.
3. Moving three places left and then three places right returns every digit to the place it started in.
4. So the two operations undo each other exactly — nothing was rounded or lost.

If wrong: Got 2700 and then 2.700, treating the trailing zeros as separate from the digits. 2.700 and 2.7 are the same number, so the answer is right and the writing suggests the zeros are being managed by hand rather than by place.

12. Why the point cannot move REASONING

Answer: **because the point marks the boundary between the ones place and the tenths place, and that boundary is fixed — what changes is which digits are on each side of it**

1. The places are always in the same order: hundreds, tens, ones, tenths, hundredths.
2. The point sits between ones and tenths to show where the whole part ends.
3. If the point moved, the places themselves would be renamed, and they are not.
4. Multiplying by 10 makes each digit worth ten times as much, which is a fact about the digits. Saying the point moved describes the same marks on the page while naming the wrong thing as changing.

If wrong: Said “because the point always stays in the same spot”, which restates the claim. The reason is that the POINT MARKS A BOUNDARY between two fixed places, so it has nothing to move relative to.

13. Why the shortcut lasted so long REASONING

Answer: **because it is correct for every whole number, and until decimals arrive every number a child multiplies by 10 is a whole number**

1. For a whole number, moving the digits left always empties the ones place, and writing a 0 there is what records it.
2. So the visible result of the correct method is always an extra zero — the shortcut and the real rule agree on every example.
3. Nothing in two years of work distinguishes them, so there is no opportunity to notice.
4. The first decimal is the first case where the ones place is filled by a digit that moved into it, and then the two methods disagree.

If wrong: Said “because it was easier”. The real answer is stronger and more uncomfortable: the shortcut was never contradicted, because it AGREES with the correct method on every whole number — which is exactly why a shortcut that scores full marks is worth being suspicious of.

Quick answers for fast checking:

#	Level	Answer
1	fluency	34
2	fluency	340
3	fluency	3400
4	fluency	6.2
5	fluency	0.62
6	fluency	0.062
7	fluency	10, 100, 1000, 10000; exponent = zeros
8	reasoning	1000; his method gives 0 for 10^0, which is 1
9	reasoning	same digits, different places; each a tenth of the one above
10	application	three steps apart, 1000 times bigger
11	application	2700, then 2.7; the moves undo each other
12	reasoning	the point marks a fixed boundary between ones and tenths
13	reasoning	it agrees with the real rule on every whole number

Lesson slides — teaching notes & timing

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

Slide	~Time	Note
1/8	0:00	

		This lesson replaces a rule that has worked flawlessly since Grade 3, so expect resistance. The claim is not that “add a zero” is wrong — it is that it describes a symptom, and the symptom stops appearing the moment decimals arrive.
2/8	0:40	Give the shortcut its due out loud. Two examples where it is completely correct. A child who feels their method is being dismissed stops listening.
3/8	1:20	THE slide. Do not supply the answer. Ask whether 2.70 is bigger than 2.7 and wait. The class settles it themselves, and that is worth more than being told.
4/8	2:15	The re-description, and this is the sentence the whole lesson turns on: the digits moved and the zero is recording an EMPTY PLACE. Point at the ones column while saying it. The zero is a consequence, never the operation.
5/8	3:15	Apply the corrected description to 2.7. Track each digit by name — the 2 goes ones to tens, the 7 goes tenths to ones. Naming digits individually is what makes this checkable rather than another rule.
6/8	4:15	Both directions, and note that the rightward half is new this year: the “Ten times the place to its right” sheet (Grade 4) did the leftward half only. Write 450, 45, 4.5, 0.45 in a column and let the class see the digits are identical throughout.
7/8	5:30	Exponent notation. The $10^3 = 30$ misreading is worth surfacing deliberately, because $10^{\sup 0} = 1$ is impossible to make sense of from the wrong reading and children meet $10^{\sup 0}$ soon.
8/8	6:45	The last prompt is the one that matters: naming what happens to a specific digit is the standard's own demand, and it cannot be answered by a child who thinks the point moves. Exit ticket after.