

GRADE 5 · NUMBER & OPERATIONS IN BASE TEN · ANSWER KEY

MULTIPLYING MULTI-DIGIT NUMBERS

Today's goal: I can fluently multiply multi-digit whole numbers using the standard algorithm.

How to use this key. Problem numbers match the student sheets. Each answer shows the steps and the slip Mr DJ sees most, so a wrong answer tells you what to reteach. Pepper levels: **Mild** warm-up, **Medium** stretch, **Spicy** challenge, **Extra Spicy** big brain.

Practice

8 problems + Mr DJ's worked example

Use: In-class practice after the deck. Item 6 is the sheet's most transferable item and children resist it: they want to redo the multiplication, and the item explicitly forbids it. Being able to reject an answer on SIZE is what catches an error in every future calculation, because nobody recalculates everything and everybody can check a magnitude. Item 4 is the same demand in its milder form — answer without calculating — and a child who computes 26598 has not done the task. Item 8 is the bank's central claim: the shift is 47×20 , not a rule about columns, and a child who gives the columns answer has the ritual that gets skipped under load. Item 7 pairs with the “Reading and comparing decimals” sheet (Grade 5) item 4 — a zero that adds nothing is not a zero that does nothing, and children who have just learned that trailing zeros are harmless over-apply it here.

Timing: 15–20 min · pairs · no calculators · items 6 and 8 on the board.

1 estimate about 1000; answer 1081

2 estimate about 4000 (130×30) or 3750 (125×30); answer 4250

3 141 — the carried 2 is added to 12 AFTER the 4×3 is done

4 about 28000 — roughly 700×40

5 he added the carry before multiplying instead of after — $(4 + 2) \times 3 = 18$ rather than $4 \times 3 + 2 = 14$

6 because 38×46 is about $40 \times 50 = 2000$, and 380 is about a fifth of that — far too small to be a slip

7 it adds nothing to the total, and it holds the tens place so the 3 stays in the hundreds

8 because the second line is not the second digit times the number — it is that digit's PLACE VALUE times the number, and the shift is what writes 940 rather than 94

1 MILD 47×23

estimate about 1000; answer 1081

1. Estimate: $50 \times 20 = 1000$.
2. $47 \times 3 = 141$. $47 \times 20 = 940$.
3. $141 + 940 = 1081$.

Watch for: Answered 235 — the second partial left as 94. Against the estimate this is less than a quarter of the expected size.

2 MILD 125×34

estimate about 4000 (130×30) or 3750 (125×30); answer 4250

1. Estimate: $125 \times 30 = 3750$, so about 4000.
2. $125 \times 4 = 500$.
3. $125 \times 30 = 3750$.
4. $500 + 3750 = 4250$.

Watch for: Answered 875, from $500 + 375$ with the second partial unshifted. Roughly a fifth of the estimate.

3 MEDIUM 47×3 step by step

141 — the carried 2 is added to 12 AFTER the 4×3 is done

1. $7 \times 3 = 21$. Write the 1 in the ones column and carry the 2 into the tens.
2. $4 \times 3 = 12$. This is 4 tens times 3, so it is 12 tens.
3. Now add the carried 2 tens: $12 + 2 = 14$ tens.
4. Write 14, giving 141. The carry is added after the multiplication, never before it.

Watch for: Showed 141 without saying where the carry entered. The order is the whole content of the item, and item 5 is what happens when it is reversed.

4 MEDIUM How big is 682×39

about 28000 — roughly 700×40

1. Round 682 to 700 and 39 to 40.
2. $700 \times 40 = 28000$.
3. Both numbers were rounded up, so the true answer will be a little less. It is 26598.
4. An estimate does not need to be close; it needs to be close enough to reject a wrong answer.

Watch for: Attempted the full multiplication. The item asks for the estimate ONLY, and being willing to answer without calculating is the habit that catches errors later.

5 SPICY Mo's 181

he added the carry before multiplying instead of after — $(4 + 2) \times 3 = 18$ rather than $4 \times 3 + 2 = 14$

1. The carried 2 is 2 tens, left over from $7 \times 3 = 21$.
2. The tens digit must be multiplied first: $4 \times 3 = 12$ tens.
3. Then the carried 2 tens are added: $12 + 2 = 14$.
4. Mo added first: $(4 + 2) \times 3 = 18$, which multiplies the carry by 3 as well as the 4. That is 4 tens too many, and $181 - 141 = 40$ confirms it.
5. An estimate of $50 \times 3 = 150$ also flags 181 as slightly too big.

Watch for: Said Mo “added when he should have multiplied”. Both operations belong; it is their ORDER that is wrong, and naming the consequence — the carry got multiplied by 3 too — is what makes 40 the predictable size of the error.

6 **SPICY** 380 must be wrong

because 38×46 is about $40 \times 50 = 2000$, and 380 is about a fifth of that — far too small to be a slip

1. Round: $40 \times 50 = 2000$.
2. 380 is less than a quarter of 2000.
3. A single wrong digit changes an answer by a little; being five times too small is a different kind of error, and it points at a whole missing partial product.
4. So the answer can be rejected without checking any of its digits — which is the point of estimating.

Watch for: Recalculated 38×46 to show 1748. That proves 380 wrong and does not use an estimate, which is what the item asked for — and in an exam nobody recalculates every answer, while everybody can check a size.

7 **SPICY** The 0 in 306

it adds nothing to the total, and it holds the tens place so the 3 stays in the hundreds

1. 306×24 needs 306×4 and 306×20 .
2. There are no tens in 306, so the tens digit contributes 0 to each partial product.
3. But the 0 keeps the 3 in the hundreds place. Without it the number is 36, and 306 is eight and a half times 36 — so the answer comes out eight and a half times too small.
4. So the two facts are both true: it contributes nothing to add, and removing it changes the number completely.

Watch for: Said “the 0 does nothing”. Half right, and it is the dangerous half — contributing nothing to ADD is not the same as doing nothing, and this is the same over-application as flattening the place-holding zero in the “Reading and comparing decimals” sheet (Grade 5).

8 **EXTRA SPICY** Why the shift is arithmetic

because the second line is not the second digit times the number — it is that digit's PLACE VALUE times the number, and the shift is what writes 940 rather than 94

1. In 47×23 , the 2 stands for 20, not 2.
2. So the second line is $47 \times 20 = 940$.
3. Written in a shifted column, the digits 9 and 4 land in the hundreds and tens, which IS 940 — the shift and the multiplication by ten are the same thing.
4. Called a layout rule, it is something extra to remember and can be skipped. Called arithmetic, it is part of the calculation and skipping it is visibly wrong.

Watch for: Said “because you have to line the columns up”. That is the layout answer, and it is the belief that makes the shift skippable. $47 \times 20 = 940$ is the reason the columns are where they are.

Exit Ticket

4 problems

Use: End of the multi-digit multiplication lesson. Item 3 is the diagnostic and it deliberately concedes that both of Leo's multiplications are correct, so there is no arithmetic slip to find — the whole task is explaining that 47×2 is not what the second line stands for. The answer to look for contains the words “the 2 means twenty”; “he forgot to shift” is the symptom, and a child holding only that has a ritual rather than a reason. Note the second half of the item: the estimate rejects 235 on SIZE, which is a much easier judgement than finding a wrong digit, and it is the habit this whole bank is built to install. Item 2's interior zero is where two true statements get collapsed — the 0 adds nothing AND holds a place — and the resulting answer is eight and a half times too small, so the estimate catches it without any checking. This is the same territory as “multiply the digits and add a zero” in the Grade 3 “Multiplying by tens” lesson, where the belief happens to work. **Timing:** 5–8 min · independent · no calculators.

1 estimate about $40 \times 50 = 2000$; answer 1748

2 estimate about $300 \times 24 = 7200$; answer 7344

3 the second partial product should be $47 \times 20 = 940$, not $47 \times 2 = 94$, because the 2 in 23 means twenty; his answer is about a quarter of the estimate of 1000

4 three partial products — $234 \times 2 = 468$ in the ones, $234 \times 50 = 11700$ in the tens, and $234 \times 100 = 23400$ in the hundreds

1 **MILD** 38×46

estimate about $40 \times 50 = 2000$; answer 1748

1. Estimate: $40 \times 50 = 2000$.
2. $38 \times 6 = 228$.
3. $38 \times 40 = 1520$ — the 4 means forty, so this line shifts one place.
4. $228 + 1520 = 1748$, which sits below the estimate as expected, since 38 and 46 were both rounded up.

Watch for: Answered 380, from $228 + 152$ with the second partial unshifted. Against an estimate of 2000 this is out by a factor of five, and the estimate is what makes that obvious without checking a single digit.

2 **MILD** 306×24

estimate about $300 \times 24 = 7200$; answer 7344

1. Estimate: $300 \times 24 = 7200$.
2. $306 \times 4 = 1224$.
3. $306 \times 20 = 6120$.
4. $1224 + 6120 = 7344$, close to the estimate.

Watch for: Answered 864, having treated 306 as 36 — the interior 0 contributes nothing to add, so it was skipped when writing rather than held as a place. 864 against 7200 is caught instantly.

3 **SPICY** Leo's 235

the second partial product should be $47 \times 20 = 940$, not $47 \times 2 = 94$, because the 2 in 23 means twenty; his answer is about a quarter of the estimate of 1000

1. $47 \times 3 = 141$ is right.
2. $47 \times 2 = 94$ is right too — but 47×2 is not what the second line asks for.
3. The 2 sits in the TENS place of 23, so it stands for twenty, and $47 \times 20 = 940$. That is ten times Leo's 94, and the shift in the written layout is what records it.
4. $141 + 940 = 1081$.
5. The estimate: 47×23 is about $50 \times 20 = 1000$. Leo's 235 is less than a quarter of that, so it can be rejected on SIZE alone, without looking at any digit.

Watch for: Said Leo “forgot to move the second line along”. That names the symptom. What makes it stick is that the 2 MEANS TWENTY, so 940 is the number the line is standing for — a child who knows only the movement has a ritual to remember, and rituals get skipped.

4 **SPICY** 234×152

three partial products — $234 \times 2 = 468$ in the ones, $234 \times 50 = 11700$ in the tens, and $234 \times 100 = 23400$ in the hundreds

1. The second number has three digits, so there are three partial products — one per digit.
2. The 2 is ones: $234 \times 2 = 468$.
3. The 5 is fifty: $234 \times 50 = 11700$, shifted one place.
4. The 1 is one hundred: $234 \times 100 = 23400$, shifted two places.
5. Each partial product is ten times further along than the last, which is why each written line moves one more place left.

Watch for: Said “three, because there are three digits” without the places. The count is the easy half; what the item asks for is what each line stands for, and that is the part that stops a line being written in the wrong column.

Lesson slides

teaching notes & timing

Slide	Time	What to do
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1	0:00	“Fluently” is the standard's word, so this lesson is about the errors that survive knowing the method, not about learning it. The estimate is the whole instructional move: it converts an invisible error into a visible one.
2	0:30	Insist on the estimate before any digits are written, every single time, including when children complain it is unnecessary. It is the only habit on this sheet that catches errors the child cannot see.
3	1:10	Work 47×3 aloud and stress the ORDER: multiply first, then add the carry. The 181 error comes from adding first, and it looks entirely reasonable on the page.
4	2:10	THE slide. Say “the 2 means twenty” and write $47 \times 20 = 940$ in full before showing the shifted layout. The layout is a consequence; the arithmetic is the reason. A child told only to “move it along one” has a ritual.
5	3:10	Add and compare with the estimate. Doing this comparison out loud every time is what makes it automatic.
6	3:50	The unshifted answer, judged against the estimate rather than against the correct answer. 235 against about 1000 is not a matter of hunting for a slip — it is the wrong size, and that is a different and much easier judgement.
7	4:45	The interior zero. Two things are true at once and children collapse them: the 0 contributes nothing to add, AND it holds a place. Show 36×24 against the estimate.
8		Show the problem and the slip. Pairs: what went wrong, and what is the right answer? Take two answers before moving on.
9		Solve it together, one step at a time. It is also the worked example at the top of the practice sheet, so students can look back at it.
10	6:00	The 234×152 question is the one that tests understanding rather than execution: three digits, three partial products, each shifted one further. Exit ticket after. Whiteboards: everyone tries Mild, then climbs. These are #1, #3, #5 on the practice sheet.
11		Fingers up: 3 = got it, 2 = almost, 1 = not yet. Pull the 1s for a quick reteach while everyone else starts the practice sheet.
12		Launch the practice sheet. Exit ticket in the last 5–8 minutes.