



GRADE 5 · MEASUREMENT & DATA · ANSWER KEY

CONVERTING UNITS WITHIN A SYSTEM

Today's goal: I can convert among different-sized standard measurement units within a system.



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 best diagnostic and it is worth setting before anything else: a child who orders by the numerals produces almost exactly the reverse of the right answer, because 0.05 km is the smallest numeral and the largest length. That is the inverse-relationship thread with nothing else in the way. Item 7 asks for the reason behind the direction rule, and the fixed-measurement argument is what makes the rule usable when a factor has been forgotten — which is most of the time. Item 5 is the “Place value and powers of ten” sheet (Grade 5) reappearing inside a measurement: 2.5000 IS 2.5, so appending zeros converts nothing, and it is the same error rather than a related one. Item 4 reuses the “Multistep problems and remainders” sheet (Grade 4) — 1.6 jugs is correct arithmetic and not an answer anybody can act on. **Timing:** 20–25 min · pairs · no conversion tables · items 6, 7 and 8 on the board.

1 3000 m, 2000 g, 4000 ml, 750 g **2** 2500 m, then 250000 cm **3** 2000 g, which is 2 kg

4 1 full jug, with 150 ml left to measure — so 2 jugs are needed, the second not full

5 because 2.5000 is the same number as 2.5 — the zeros after the last digit add nothing; converting means the DIGITS move, so the 5 has to travel from the tenths place to the hundreds

6 45 cm, 480 mm, 0.5 m, 0.05 km

7 because the thing being measured does not change — if you count it in smaller pieces, you need more of them to cover the same amount

8 because conversions within a system are exact, tidy relationships (1 km = 1000 m exactly), while metres to feet is an awkward, approximate conversion that is not part of this skill

1 **MILD** Four to smaller units

3000 m, 2000 g, 4000 ml, 750 g

1. Each goes to a smaller unit, so each number gets bigger.
2. $3 \times 1000 = 3000$ m. $2 \times 1000 = 2000$ g. $4 \times 1000 = 4000$ ml.
3. $0.75 \times 1000 = 750$ g — the digits move three places left, so the 5 lands in the tens.

Watch for: Answered 0.75000 g for the last — zeros appended. It is the same amount as 0.75, so it is still less than a gram rather than 750 of them.

2 **MEDIUM** 2.5 km twice over

2500 m, then 250000 cm

1. 2.5 km to m: $2.5 \times 1000 = 2500$ m.
2. 2500 m to cm: $2500 \times 100 = 250000$ cm.
3. So 1 km is 100 000 cm, and 2.5 km is two and a half times that.
4. Doing it in two steps means never needing to remember a single km-to-cm factor.

Watch for: Multiplied by 1000 and then by 1000 again, giving 2500000. There are 100 cm in a metre, not 1000 — taking one step at a time makes each factor an easy one.

3 **MEDIUM** 1 kg 250 g + 750 g

2000 g, which is 2 kg

1. Put everything in grams: 1 kg is 1000 g, so the first amount is 1250 g.
2. $1250 + 750 = 2000$ g.
3. 2000 g is 2 kg exactly.
4. Check: a bit over a kilo plus most of a kilo should be about 2 kg.

Watch for: Answered 1 kg 1000 g, which is a correct amount written in a form nobody uses — 1000 g is another kilogram, so it should be carried to give 2 kg.

4 **MEDIUM** Jugs of milk

1 full jug, with 150 ml left to measure — so 2 jugs are needed, the second not full

1. 0.4 l is 400 ml.
2. $400 \div 250 = 1$ with 150 left over.
3. So one full jug plus another 150 ml — the jug must be used twice, and the second time it is not full.
4. The remainder is 150 ml of milk, which is a real amount, not part of a jug — the “Multistep problems and remainders” sheet (Grade 4) question of what a remainder means here.

Watch for: Answered 1.6 jugs. The division is right and jugs are not poured in fractions when you are measuring; the useful answer says one full jug and 150 ml more.

5 **SPICY** Why 2.5000 converts nothing

because 2.5000 is the same number as 2.5 — the zeros after the last digit add nothing; converting means the DIGITS move, so the 5 has to travel from the tenths place to the hundreds

1. Zeros written after the final digit of a decimal change nothing: 2.5, 2.50 and 2.5000 are all the same amount.
2. So the child has rewritten the number rather than converted it.
3. Multiplying by 1000 moves every digit three places left: the 2 goes from ones to thousands and the 5 from tenths to hundreds.
4. That gives 2500 — where the zeros are places the digits have vacated, not padding added by hand.
5. This is the same error as “multiplying by 10 adds a zero” in the “Place value and powers of ten” sheet (Grade 5).

Watch for: Said “you cannot just add zeros”. That is the instruction and not the reason; what makes it stick is that 2.5000 IS 2.5, so the operation left the number untouched.

6 **SPICY** Four lengths in order

45 cm, 480 mm, 0.5 m, 0.05 km

1. Convert everything to one unit — centimetres is convenient: 0.5 m = 50 cm; 45 cm; 480 mm = 48 cm; 0.05 km = 5000 cm.
2. In order: 45, 48, 50, 5000.
3. So 45 cm, 480 mm, 0.5 m, 0.05 km.
4. Notice 0.05 km looks like the smallest number and is by far the biggest length — the numeral alone tells you nothing until the unit is known.

Watch for: Ordered by the numerals: 0.05 km, 0.5 m, 45 cm, 480 mm — which is very nearly the reverse of the right answer. This is the inverse-relationship thread in its purest form: the smallest number here belongs to the biggest length.

7 **SPICY** Why smaller unit means bigger number

because the thing being measured does not change — if you count it in smaller pieces, you need more of them to cover the same amount

1. A 2-metre table is still 2 metres long however you describe it.
2. Counted in centimetres, each piece is a hundredth of a metre, so 200 of them are needed.
3. The length stayed the same and the COUNT went up, because each unit of counting got smaller.
4. So it is not a rule about numbers; it is a fact about measuring, and that is why it needs no factor to apply.

Watch for: Said “because you multiply”. That describes the arithmetic and not the reason. The fixed-measurement argument is what makes the direction decidable when the factor is forgotten.

8 **EXTRA SPICY** Why within a system

because conversions within a system are exact, tidy relationships (1 km = 1000 m exactly), while metres to feet is an awkward, approximate conversion that is not part of this skill

1. Inside the metric system the factors are powers of ten, so converting is moving digits.
2. Inside the customary system the factors are exact too, though not tens: 12 inches to a foot, 16 ounces to a pound.
3. Metres to feet is neither tidy nor exact — about 3.28 feet to a metre — so it would turn every question into a rounding exercise.
4. The skill being learned is the DIRECTION and the place-value movement, and mixing systems would bury that under arithmetic.

Watch for: Said “because you should not mix them up”. The point is not confusion but the kind of number: within a system the factors are exact and often powers of ten, which is what makes the digit-moving idea visible.

Exit Ticket

4 problems

Use: End of the converting-units lesson. Item 3 asks for a check that does NOT need the conversion factor, and that is the assessment: a child who can only convert when they remember whether to multiply or divide has nothing to fall back on, while “smaller unit, bigger number” and picturing the answer both work unaided. Judging 25000 m as 25 km is the strongest version, because it rejects the answer as a LENGTH rather than as arithmetic. This is the inverse-relationship thread's sixth appearance — an earlier lesson, the Grade 3 “Equivalent fractions and comparing” lesson, the Grade 3 “Volume and mass” lesson, the “Comparing fractions” sheet (Grade 4), the “Reading and comparing decimals” sheet (Grade 5) and the “Converting measurement units” sheet (Grade 4) — and Grade 5 adds decimals and two-step conversions, which is why the

direction gets harder to feel. Item 4 is worth marking for the GENERAL statement: adding needs a common unit, which is the same rule as a common denominator (the “Adding and subtracting unlike denominators” sheet (Grade 5)) and aligned places (the “Decimal arithmetic” sheet (Grade 5)). Three banks, one idea, and a child who holds it once does not need it three times.

Timing: 5–10 min · independent · conversion tables NOT provided.

1 1.5 kg (smaller number), 400 ml (bigger), 3200 mm (bigger)

2 1200 ml, which is 1.2 l

3 she multiplied by 100 because 100 is the number in the relationship, without asking which way; the check is that metres are BIGGER than centimetres, so the number must get smaller — and 25000 m is 25 km, which is a distance, not a table

4 because 2 and 30 count different-sized things — 2 metres and 30 centimetres — so there is nothing to add until both are in the same unit; 2 m is 200 cm, so the answer is 230 cm or 2.3 m

1

MEDIUM

Three conversions

1.5 kg (smaller number), 400 ml (bigger), 3200 mm (bigger)

1. 1500 g to kg: kilograms are bigger, so fewer of them — $1500 \div 1000 = 1.5$ kg.
2. 0.4 l to ml: millilitres are smaller, so more of them — $0.4 \times 1000 = 400$ ml.
3. 3.2 m to mm: millimetres are smaller — $3.2 \times 1000 = 3200$ mm.
4. In each case the direction was decided before any arithmetic.

Watch for: Answered 1500000 g-worth for the first, or 0.4000 and 3.2000 for the others — zeros appended rather than digits moved. 0.4000 is the same amount as 0.4, so nothing was converted.

2

MEDIUM

The bottle

1200 ml, which is 1.2 l

1. Both amounts must be in the same unit first: 1.5 l is 1500 ml.
2. $1500 - 300 = 1200$ ml.
3. 1200 ml is 1.2 l.
4. Check: 1.2 l is a bit less than the 1.5 l we started with, which is right after pouring some out.

Watch for: Answered 1.2 ml or 1200 l — the arithmetic right and the unit carried over from the wrong line. Saying roughly what the answer should be first (a bit over a litre) catches it.

3 SPICY Mia's 25000 m

she multiplied by 100 because 100 is the number in the relationship, without asking which way; the check is that metres are BIGGER than centimetres, so the number must get smaller — and 25000 m is 25 km, which is a distance, not a table

1. The relationship is $1\text{ m} = 100\text{ cm}$, and Mia used the 100 without deciding whether to multiply or divide.
2. Metres are bigger than centimetres, so a length is fewer metres than centimetres. The number must go DOWN.
3. $250 \div 100 = 2.5\text{ m}$.
4. The factor-free check: picture the answer. 25000 m is 25 km, which nobody would call the length of anything in a classroom.
5. Her answer is ten thousand times too big — a factor of 100 the wrong way is a factor of 10000 in total.

Watch for: Said Mia “should have divided”. Correct and it is the answer rather than a method — the item asks for a way to SPOT the error, and both the direction rule and picturing the answer work when a child cannot remember which operation to use.

4 SPICY Rob's 32

because 2 and 30 count different-sized things — 2 metres and 30 centimetres — so there is nothing to add until both are in the same unit; 2 m is 200 cm, so the answer is 230 cm or 2.3 m

1. A number on its own means nothing here; 2 metres and 30 centimetres are not 32 of anything.
2. Convert first: $2\text{ m} = 200\text{ cm}$.
3. $200 + 30 = 230\text{ cm}$, which is 2.3 m.
4. Rob's 32 cm is much shorter than the 2 m he started with, so it fails a size check too.
5. This is the same rule as needing a common denominator before adding fractions, and lining up places before adding decimals: adding always needs a common unit.

Watch for: Gave 230 cm without saying why 32 is meaningless. The general statement is the valuable part, because it is the same rule as in fractions and decimals — a child who has it once does not need it three times.

Lesson slides

teaching notes & timing

Slide	Time	What to do
1	0:00	This continues the “Converting measurement units” sheet (Grade 4) rather than starting over. The direction rule is the same; what is new is decimals and two-step conversions, both of which make the direction harder to feel because the numbers stop being tidy.
2	0:35	The sentence that makes the whole topic reasonable: the measurement does not change, only the unit you count it in. Hold up an object and count it in cm then in m.
3	1:10	The direction rule, and get the class to say it: smaller unit, bigger number. It works for every conversion in the lesson and needs no factor remembered.
4	2:00	THE slide. Judge the wrong answer as a LENGTH rather than as arithmetic — 25000 m is 25 km. A child who can picture 25 km will not accept it for a table, and that is a better check than any rule.
5	2:55	Decimals, and name the “Place value and powers of ten” sheet (Grade 5) connection explicitly: the digits move, and the zeros are a consequence. 2.5000 is still 2.5, so appending zeros converts nothing.
6	3:55	Two-step conversions. Do them one step at a time on the board rather than reaching for a single factor — a child who multiplies by 1000 and then by 100 can always reconstruct the 100 000.
7	4:50	Mixed units, and the connection worth making: this is the same rule as needing a common denominator (the “Adding and subtracting unlike denominators” sheet (Grade 5)) and aligning decimal places (the “Decimal arithmetic” sheet (Grade 5)). Adding always needs a common unit.
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	Three conversions and one two-step problem. Ask for bigger-or-smaller before each. Exit ticket after. Whiteboards: everyone tries Mild, then climbs. These are #1, #2, #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.
