

GRADE 7 · THE NUMBER SYSTEM · ANSWER KEY

FOUR OPERATIONS WITH RATIONAL NUMBERS

Today's goal: I can add rational numbers to solve mathematical problems, add rational numbers to solve real-world problems, subtract rational numbers to solve mathematical problems, subtract rational numbers to solve real-world problems, multiply rational numbers to solve mathematical problems, multiply rational numbers to solve real-world problems, divide rational numbers to solve mathematical problems and divide rational numbers to solve real-world problems.



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

9 problems

Use: During the lesson after the deck. Item 8 is the one worth discussing as a class — the arithmetic gives an answer the context makes surprising, and noticing that is the skill. **Timing:** 15–25 min · pairs or independent · circulate on 3, 7 and 9. Require an answer in words on every item, not just the reasoning ones.

- 1 \$25 2 -\$54 3 8°C 4 -4°C 5 15 degrees 6 -\$24 each 7 -\$29 — the account is \$29 overdrawn
8 150 m — the diver is now 150 m ABOVE sea level 9 -\$12 each — half the previous share

- 1 **MILD** \$120 less a \$95 payment

\$25

1. $120 + (-95) = 25$. The balance is \$25, still in credit.

Watch for: Answered -25 by subtracting the wrong way round.

- 2 **MEDIUM** Three charges of \$18

-\$54

1. A repeated change: $-18 \times 3 = -54$.

2. The balance falls by \$54.

Watch for: Answered -21 by adding -18 and -3. The 3 counts charges, it is not money.

- 3 **MEDIUM** -7°C rises 15

8°C

1. $-7 + 15 = 8$. Seven of the rise reaches 0, leaving 8.

Watch for: Answered -22 by adding the sizes.

- 4 **MEDIUM** 6°C falls 2 per hour for 5 hours

-4°C

1. Total change: $-2 \times 5 = -10$.

2. New temperature: $6 + (-10) = -4^\circ\text{C}$.

3. It passed through zero, ending 4 degrees below freezing.

Watch for: Answered 4 by subtracting 10 from 6 as though the result could not go below zero.

- 5 **MEDIUM** How much warmer is 8 than -7?

15 degrees

1. $8 - (-7) = 8 + 7 = 15$.

2. Count: -7 up to 0 is 7, then 0 up to 8 is 8. $7 + 8 = 15$.

Watch for: Answered 1 by computing $8 - 7$.

- 6 **MEDIUM** \$96 debt shared by 4

-\$24 each

1. $-96 \div 4 = -24$. Each person owes \$24.

Watch for: Answered 24 without the sign.

7 **SPICY** Final balance from \$120

-\$29 — the account is \$29 overdrawn

1. Start 120, then -95 , then -54 .
2. $120 - 95 = 25$. Then $25 - 54 = -29$.
3. The balance is $-\$29$, meaning the account is overdrawn by \$29.
4. Check by totalling the outgoings first: $95 + 54 = 149$, and $120 - 149 = -29$. Same answer, different route.

Watch for: Stopped at 25 having applied only the payment, or answered 29 without the sign.

8 **SPICY** Diver at -200 m rises 350 m

150 m — the diver is now 150 m ABOVE sea level

1. $-200 + 350 = 150$.
2. The rise of 350 is more than the 200 needed to reach the surface, so the diver passes it.
3. In words: the diver is 150 m above sea level — out of the water entirely, which is worth noticing.
4. This is a good check that the numbers describe something sensible. A diver 150 m in the air suggests the question is about a drone, a balloon, or that the rise was overstated.

Watch for: Answered -150 , assuming the diver must stay below the surface. The arithmetic does not know about water; you have to interpret it.

9 **EXTRA SPICY** Half forgiven, then shared

-\$12 each — half the previous share

1. Half of -96 remains: $-96 \div 2 = -48$.
2. Shared four ways: $-48 \div 4 = -12$.
3. Each person owes \$12, which is half of the \$24 from question 6.
4. That makes sense: halving the debt halves every share, because dividing by 2 and then by 4 is dividing by 8, and $-96 \div 8 = -12$.
5. Two divisions in a row combine into one by multiplying the divisors.

Watch for: Divided by 2 only, or by 4 only. The debt is halved AND shared, which is two operations.

Homework

8 problems

Use: Closes G7 Number System. Items 1–6 are a matched trio: the same numbers, one word different, a different operation. Item 8 is the hardest and the most worthwhile. **Timing:** ~15 min at home · independent · review item 7 as the next-day warm-up; the word ‘each’ is the whole difference.

1 -7°C

2 $-\$25$ — overdrawn by \$25

3 $-\$48$

4 -15°C

5 \$15 each week

6 $-\$73$

7 One is a single change, the other is repeated

8 Positive from the debtor's side — it reduces the debt

1 **MILD** -3°C falls 4

-7°C

1. $-3 + (-4) = -7$. Both moves go left.

Watch for: Answered 1 by subtracting the sizes.

2 **MEDIUM** \$60 less an \$85 payment

-\$25 — overdrawn by \$25

1. $60 + (-85) = -25$.
2. The account is \$25 overdrawn.

Watch for: Answered 25 with no sign, which reads as credit.

3 **MEDIUM** Four charges of \$12

-\$48

1. $-12 \times 4 = -48$.

Watch for: Answered -16 by adding -12 and -4 .

4 **MEDIUM** -3°C falls 4 per hour for 3 hours

-15°C

1. Total change: $-4 \times 3 = -12$.
2. New temperature: $-3 + (-12) = -15^{\circ}\text{C}$.

Watch for: Answered -7 , treating it as a single fall of 4 and ignoring the three hours.

5 **MEDIUM** \$75 repaid over 5 weeks

\$15 each week

1. $75 \div 5 = 15$. Fifteen dollars is repaid each week.

Watch for: Answered -15 without considering which direction the money moves.

6 **SPICY** Final balance from \$60

-\$73

1. $60 - 85 = -25$. Then $-25 - 48 = -73$.
2. Or total the outgoings: $85 + 48 = 133$, and $60 - 133 = -73$.
3. The account is \$73 overdrawn.

Watch for: Stopped at -25 , or lost the sign partway and answered 73.

7 **SPICY** Why do 4 and 5 differ?

One is a single change, the other is repeated

1. Question 1 has one fall of 4 degrees: add -4 once, giving -7 .
2. Question 4 has a fall of 4 degrees in EACH of 3 hours: multiply first, $-4 \times 3 = -12$, then add.
3. The numbers -3 and 4 appear in both, but the words 'each hour for 3 hours' change the operation.
4. This is why the operation comes from the situation, not from the numbers on the page. Spotting 'each' is what signals a repeated change.

Watch for: Said question 4 should also be -7 . The three hours are doing work; ignoring them ignores most of the question.

8 **EXTRA SPICY** Is the repayment positive or negative?

Positive from the debtor's side – it reduces the debt

1. The debt is $-\$75$. Each week \$15 is paid, moving the balance UP toward zero.
2. So the weekly change is $+\$15$: $-75 + 15 + 15 + 15 + 15 + 15 = 0$.
3. A NEGATIVE weekly amount would mean the debt was growing by \$15 a week, not shrinking.
4. Which sign is right depends on what you are measuring: the change in the balance is $+15$, while the amount handed over each week is just \$15 of cash.
5. The lesson: the sign is not a property of the number, it is a statement about direction in a particular situation — so say which situation you mean.

Watch for: Answered negative because the problem mentions a debt. The debt is negative; the repayment moves against it and so is positive.

Exit Ticket

4 problems

Use: End of the four-operations lesson, closing G7 Number System. 5–8 min, independent. Every item requires an answer in words, which is where the marking value sits. **Timing:** 5–8 min · independent. Mark the WORDS as much as the number — a correct -12 with no interpretation is half an answer.

1 $-\$15$ — the account is $\$15$ overdrawn

2 -12 degrees — twelve degrees colder

3 17 degrees warmer

4 $-84 \div 4 = -21$ — each owes $\$21$

1  MEDIUM \$45 balance, \$60 payment

$-\$15$ — the account is $\$15$ overdrawn

- $45 + (-60) = -15$, or $45 - 60 = -15$.
- The balance is $-\$15$.
- In words: the account is overdrawn by $\$15$ — they owe the bank $\$15$.
- The negative sign is what tells you it is a debt rather than a balance.

Watch for: Answered 15 with no sign, which reads as $\$15$ in credit — the opposite of the truth. The sign carries the meaning here.

2  MEDIUM Falls 3 degrees each hour for 4 hours

-12 degrees — twelve degrees colder

- A repeated change of the same size is multiplication: $-3 \times 4 = -12$.
- The total change is -12 degrees, meaning it is 12 degrees colder than when it started.
- Note this is not $-3 + (-4) = -7$. The 4 counts the hours; it is not a temperature.

Watch for: Answered -7 by adding the two numbers. Ask what each number measures — degrees and hours cannot be added.

3  MEDIUM -5°C to 12°C — how much warmer?

17 degrees warmer

- Difference = later – earlier = $12 - (-5) = 12 + 5 = 17$.
- Count it: -5 up to 0 is 5, then 0 up to 12 is 12. $5 + 12 = 17$.
- The answer is positive because noon was warmer. ‘How much warmer’ asks for a distance, and distances are positive.

Watch for: Answered 7 by computing $12 - 5$. The two temperatures are on opposite sides of zero, so the journeys add.

4  SPICY Four friends share an $\$84$ debt

$-84 \div 4 = -21$ — each owes $\$21$

- Write the debt as -84 and share it equally: $-84 \div 4 = -21$.
- Each friend's share is $-\$21$.
- In words: each friend owes $\$21$.
- The negative sign belongs to the debt, not to the friends' number. Dividing a negative by a positive keeps it negative, which is right — sharing a debt does not turn it into money.

Watch for: Answered 21 without the sign, or -336 by multiplying. Sharing divides; the sign survives because a shared debt is still a debt.

Lesson slides

teaching notes & timing

Slide	Time	What to do
1	0:00	Frame it: the arithmetic is done. The skill now is choosing it and interpreting it.
2	1:00	Hook — poll -7 vs -12 . Do NOT resolve. -7 is popular because both numbers are visible and adding is familiar.
3	2:30	The four situation types. Keep this list visible for the practice sheet.
4	4:30	WE1 — resolve the hook. The killer question is ‘what does the 4 measure?’ Hours are not degrees.
5	7:00	WE2 — insist on words. Mark the words on the exit ticket; students calibrate to what is marked.
6	11:00	The diver. The point is not the arithmetic but noticing when a correct answer describes something odd.
8	9:00	CFU — all-student response. 17 degrees. Watch for 7, which misses the crossing of zero. Whiteboards: everyone tries Mild, then climbs. These are #1, #2, #7 on the practice sheet.
9		Fingers up: 3 = got it, 2 = almost, 1 = not yet. Pull the 1s for a quick reteach while everyone else starts the practice sheet.

10	13:30	Launch the in-class practice sheet. This closes G7 Number System. Launch the practice sheet. Exit ticket in the last 5–8 minutes.
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