Grade 7 · Unit 5 · Assessment Guide

Rational Number Arithmetic

For the Parent or Teacher — What to look for

Unit 5 is rational number arithmetic, especially with negatives. THE classic errors: dropping the negative sign, confusing subtraction with addition of a negative, the 'negative times negative' confusion, and misinterpreting context (e.g., direction, debt). Watch for whether students use number line reasoning or memorized rules — a student who only knows the rules can still get the wrong sign in word problems.

Part A — Signed number facts

- −3, −13, −3, −8, −12, 28, −5, 4.
- ★ Watch for: students who answer −7 + 4 = −11 (treating it like −7 − 4). This means they don't have number line intuition.
- Watch (−4)(−7): should be POSITIVE 28.

Problem 1 — Number line addition

- (a) 3. (b) −7. (c) −3. (d) −7.
- Strong: shows arrows / jumps on the number line. Weak: just gives an answer (rules only).
- ★ Number line thinking is what makes this unit click. Don't accept only numerical answers — the diagram should be there.

Problem 2 — Subtraction as adding opposite

- (a) −7 + (−3) = −10. (b) 4 + 6 = 10. (c) −9 + 2 = −7.
- ★ THE Unit 5 transformation: a − b = a + (−b).
- Strong: recognizes this lets you handle subtraction with the addition rules. Weak: stays in subtraction mode and confuses signs.

Problem 3 — Multiplication signs

- (a) −20. (b) 18. (c) −16.
- Rules: ++ → +, −− → +, +− → −, −+ → −.
- ★ Students should be able to state the rule symbolically AND explain it (different from just chanting it).

Problem 4 — Scuba diver (signed velocity)

- (a) −12 m (12 m below surface).
- (b) +18 m (above the surface 6 minutes ago — but a diver wouldn't be there! Strong students notice this is an extrapolation that doesn't match physical reality).
- (c) position = −3 × time. The −3 is velocity (negative because going down).
- ★ Velocity = signed quantity. Strong students explain the sign as direction.

Problem 5 — Bank account

- (a) 40 + 30 − 50 = $20.
- (b) 20 − 75 = −$55.
- (c) Negative balance = debt; you owe the bank.
- ★ Context understanding is the goal here, not just arithmetic.

Problem 6 — Temperature changes

- Noon: −8 + 17 = 9°F.
- Sunset: 9 − 11 = −2°F.
- Strong: number line shows clear sequence of jumps. Weak: errors with sign of intermediate steps.

Problem 7 — Solving with negatives

- (a) x = −5. (b) y = −6. (c) m − (−7) = m + 7, so m = −2. (d) z = −40.
- ★ (c) and (d) are the diagnostics. (c) requires recognizing m − (−7) = m + 7. (d) requires multiplying both sides by −4 (sign matters).
- Weak: drops the negative sign in (d), gets z = 40.

Problem 8 — Diego's error

- Diego is WRONG. He treated − (−3) as −3, but it's actually +3.
- −5 − (−3) = −5 + 3 = −2.
- ★ THE classic 'double negative' error.
- Strong: explains that subtracting a negative is the same as adding a positive.

Problem 9 — Why does (−)(−) = (+)?

- Strong arguments:
- • Pattern: 3×(−4) = −12, 2×(−4) = −8, 1×(−4) = −4, 0×(−4) = 0, (−1)×(−4) = 4 (continuing the pattern, adding 4 each step).
- • Distributive: 0 = (−4)(3 + (−3)) = (−4)(3) + (−4)(−3) = −12 + (−4)(−3), so (−4)(−3) = 12.
- • Context: lose $3 per day, 4 days ago you had $12 more (negative time × negative rate = positive change).
- Weak: 'because the rule says so.'
- ★ A pattern-based or distributive argument is the gold standard.

Problem 10 — Story for −15 + 8 = −7

- Many valid stories. E.g., 'The elevator went down 15 floors, then up 8 floors. It is now 7 floors below where it started.' Or 'I owe $15. I pay back $8. I still owe $7.'
- Strong: the story matches the structure (15 in one direction, 8 in the opposite, ending up at −7).
- Weak: numbers right but story doesn't model the operation.

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