Substitution Arithmetic — Practice

CKSTEM Math Problem Solving · Grades 5–8

1 REPEATED ADDITION

Using the rule a ★ b means a added to itself b times, compute 3 ★ 4.

WORK IT OUT HERE

2 REPEATED ADDITION

Using the rule a ★ b means a added to itself b times, compute 7 ★ 5.

WORK IT OUT HERE

3 REPEATED ADDITION

Using the rule a ★ b means a added to itself b times, if 2 ★ n = 16, find n.

WORK IT OUT HERE

4 ARITHMETIC TRAIL

If a ★ b ★ c means an arithmetic sequence starting at a with step b and c terms, compute 2 ★ 3 ★ 4.

WORK IT OUT HERE

5 ARITHMETIC TRAIL

If a ★ b ★ c means an arithmetic sequence starting at a with step b and c terms, compute 3 ★ 5 ★ 6.

WORK IT OUT HERE

6 ARITHMETIC TRAIL

If a ★ b ★ c means an arithmetic sequence starting at a with step b and c terms, compute 3 ★ 4 ★ 8.

WORK IT OUT HERE

7 INSIDE OUT

A rule says $a \diamond b = 2a + b$. Compute $3 \diamond (1 \diamond 4)$.

WORK IT OUT HERE

8 INSIDE OUT

A rule says $a \diamond b = 3a - b$. Compute $4 \diamond (2 \diamond 5)$.

WORK IT OUT HERE

9 INSIDE OUT

A rule says $a \diamond b = 2a - 3b$. Compute $6 \diamond (5 \diamond (2 \diamond 1))$.

WORK IT OUT HERE

10 SUBSTITUTE AND SOLVE

A rule says $a \blacklozenge b = (a + b) \div 2$. If $4 \blacklozenge x = 5$, find x.

WORK IT OUT HERE

11 SUBSTITUTE AND SOLVE

A rule says $a \blacklozenge b = (a + 2b) \div 3$. If $3 \blacklozenge x = 5$, find x.

WORK IT OUT HERE

12 SUBSTITUTE AND SOLVE

A rule says $a \blacklozenge b = (a + b) \div (1 + ab)$. If $2 \blacklozenge x = 3/7$, find x.

WORK IT OUT HERE

13 DECODE THE RULE

A rule satisfies $1 \star 1 = 4$, $1 \star 2 = 6$, and $2 \star 1 = 7$. Assuming $a \star b = ma + nb + c$, compute $3 \star 4$.

WORK IT OUT HERE

14 DECODE THE RULE

A rule satisfies $1 \star 1 = 8$, $1 \star 2 = 10$, and $2 \star 1 = 11$. Assuming $a \star b = ma + nb + c$, find the value of x for which $x \star 2 = 22$.

WORK IT OUT HERE

15 DECODE THE RULE

A rule satisfies 1 ☆ 1 = 6, 2 ☆ 3 = 17, and 3 ☆ 2 = 16. Assuming a ☆ b = ma + nb + c, find the value of x for which x ☆ 3 = 23.

WORK IT OUT HERE

16 DECODE AND CHAIN

A rule satisfies 1 ☆ 1 = 5, 1 ☆ 2 = 8, and 2 ☆ 1 = 8. Assuming a ☆ b = ab + ma + nb, compute 3 ☆ 4.

WORK IT OUT HERE

17 DECODE AND CHAIN

A rule satisfies 1 ☆ 1 = 6, 1 ☆ 2 = 10, and 2 ☆ 1 = 9. Assuming a ☆ b = ab + ma + nb, find the value of x for which x ☆ 2 = 18.

WORK IT OUT HERE

18 DECODE AND CHAIN

A rule satisfies 1 ☆ 1 = 4, 1 ☆ 2 = 6, and 2 ☆ 1 = 7. Assuming a ☆ b = ab + ma + nb, compute 3 ☆ (2 ☆ 1).

WORK IT OUT HERE

Answer Key

Each answer comes with a hint that names the move. The tag says which video to rewatch if you are stuck.

1. **12** — *Repeated Addition*
Rewrite the star as multiplication of the two numbers.

2. **35** — *Repeated Addition*
Replace the star with a times sign once you see the repeated copies.

3. **n = 8** — *Repeated Addition*
Translate the star into multiplication, then divide both sides by the known factor.

4. **26** — *Arithmetic Trail*
Write the four-term trail with step 3, then pair the ends with the Gauss formula.

5. **93** — *Arithmetic Trail*
Find the last term as start plus step times (count minus one), then apply count × (first + last) ÷ 2.

6. **136** — *Arithmetic Trail*
Locate the eighth term using step 4, then Gauss-pair the trail.

7. **12** — *Inside Out*
Evaluate the inner bracket with the rule first, then plug that number into the outer expression.

8. **11** — *Inside Out*
Apply the rule to the inner bracket to get a single number, then apply the rule once more outside.

9. **−9** — *Inside Out*
Resolve the innermost bracket first, then move outward one layer at a time.

10. **x = 6** — *Substitute and Solve*
Substitute the rule, multiply both sides by 2, then isolate the unknown.

11. **x = 6** — *Substitute and Solve*
Substitute the rule, clear the denominator, then solve the linear equation.

12. **x = −11** — *Substitute and Solve*
Substitute the rule and cross-multiply; the quadratic terms cancel and leave a linear equation.

13. **16** — *Decode the Rule*
Subtract pairs of equations to isolate m and n, then back-solve for c.

14. **x = 5** — *Decode the Rule*
Decode m, n, and c from the three examples, then substitute into the target equation and isolate the unknown.

15. **x = 4** — *Decode the Rule*
Use differences between equations to get m and n quickly, then plug back to find c and solve.

16. **26** — *Decode and Chain*
Subtract the 1 ☆ 1 equation from each other to isolate m and n, then substitute into the target.

17. **x = 3** — *Decode and Chain*
Decode m and n from the examples, then turn the target into a linear equation in the unknown.

18. **34** — *Decode and Chain*
Decode m and n, evaluate the inner bracket with the rule, then apply the rule outward once more.