Year 9 · Algebra: Lines, Rules & Solving Equations

Name: _____ Date: _____

Kia ora! This sheet helps you practise tidying up expressions, solving equations, and working with straight-line rules like y = mx + c. Show your steps, they matter as much as the answer.

Warm-up

1. Simplify: 5a + 3b − 2a + 7b

2. Expand: 4(x + 3)

3. Find the value of 2x − 5 when x = 3.

4. Solve: x + 7 = 12

Practice

5. Expand and simplify: 3(2x + 4) − 5

6. Factorise fully: 12y + 18

7. Solve: ½x + 3 = 7

8. A taxi from Avondale charges a $4 fixed fee plus $2.50 for each kilometre travelled. Write a rule for the total cost C (in dollars) for k kilometres, then find the cost of a 6 km trip.

9. Mere builds patterns with matchsticks. Pattern 1 uses 4 matches, Pattern 2 uses 7, and Pattern 3 uses 10. Describe the rule in words, write it using n for the pattern number, and find how many matches Pattern 10 needs.

10. The perimeter of a rectangle is P = 2l + 2w. Rearrange the formula to make w the subject, then find w when P = 30 cm and l = 8 cm.

Challenge

11. Solve the inequality 5 − 2x ≤ 11. Show clearly what happens when you divide by a negative number.

12. A straight line gives this table of values, x: −2, −1, 0, 1, 2 and y: 7, 5, 3, 1, −1. Find the gradient m and y-intercept c, write the equation, state whether the line slopes up or down, and predict y when x = 5.

Answer key (for parents and tutors)

1. Simplify: $5a + 3b - 2a + 7b$
   Collect like terms. The a-terms: $5a - 2a = 3a$. The b-terms: $3b + 7b = 10b$. Answer: $3a + 10b$.

2. Expand: $4(x + 3)$
   Multiply each term inside the bracket by 4: $4 \times x = 4x$ and $4 \times 3 = 12$. Answer: $4x + 12$.

3. Find the value of $2x - 5$ when $x = 3$.
   Substitute $x = 3$: $2 \times 3 - 5 = 6 - 5 = 1$. Answer: 1.

4. Solve: $x + 7 = 12$
   Subtract 7 from both sides: $x = 12 - 7 = 5$. Answer: $x = 5$.

5. Expand and simplify: $3(2x + 4) - 5$
   Expand the bracket: $3 \times 2x = 6x$ and $3 \times 4 = 12$, giving $6x + 12 - 5$. Combine the numbers: $12 - 5 = 7$. Answer: $6x + 7$.

6. Factorise fully: $12y + 18$
   Find the highest common factor of 12 and 18, which is 6. Divide each term by 6: $12y \div 6 = 2y$ and $18 \div 6 = 3$. Answer: $6(2y + 3)$.

7. Solve: $\frac{1}{2}x + 3 = 7$
   Subtract 3 from both sides: $\frac{1}{2}x = 4$. Multiply both sides by 2: $x = 8$. Answer: $x = 8$.

8. A taxi from Avondale charges a $4 fixed fee plus $2.50 for each kilometre travelled. Write a rule for the total cost C (in dollars) for k kilometres, then find the cost of a 6 km trip.
   The fixed fee is $4 and each km adds $2.50, so $C = 4 + 2.50k$. For $k = 6$: $C = 4 + 2.50 \times 6 = 4 + 15 = 19$. Answer: $C = 4 + 2.50k$, and a 6 km trip costs $19.

9. Mere builds patterns with matchsticks. Pattern 1 uses 4 matches, Pattern 2 uses 7, and Pattern 3 uses 10. Describe the rule in words, write it using n for the pattern number, and find how many matches Pattern 10 needs.
   Each pattern adds 3 matches (4, 7, 10 …), so the number goes up by a constant 3. Starting value logic: matches = 3 × (pattern number) + 1. In words: multiply the pattern number by 3 and add 1. As a rule: $t = 3n + 1$. Check $n = 2$: $3 \times 2 + 1 = 7$ ✓. For Pattern 10: $t = 3 \times 10 + 1 = 31$. Answer: $t = 3n + 1$, so Pattern 10 needs 31 matches.

10. The perimeter of a rectangle is $P = 2l + 2w$. Rearrange the formula to make w the subject, then find w when $P = 30$ cm and $l = 8$ cm.
    Subtract $2l$ from both sides: $P - 2l = 2w$. Divide both sides by 2: $w = (P - 2l) \div 2$. Substitute $P = 30$ and $l = 8$: $w = (30 - 16) \div 2 = 14 \div 2 = 7$. Answer: $w = (P - 2l) \div 2$, and $w = 7$ cm.

11. Solve the inequality $5 - 2x \leq 11$. Show clearly what happens when you divide by a negative number.
    Subtract 5 from both sides: $-2x \leq 6$. Now divide both sides by -2. Dividing (or multiplying) an inequality by a negative number reverses the inequality sign, so $\leq$ becomes $\geq$: $x \geq -3$. Answer: $x \geq -3$.

12. A straight line gives this table of values, x: −2, −1, 0, 1, 2 and y: 7, 5, 3, 1, −1. Find the gradient m and y-intercept c, write the equation, state whether the line slopes up or down, and predict y when $x = 5$.
    As x increases by 1, y decreases by 2 each time ($7 \to 5 \to 3 \to 1 \to -1$), so the gradient $m = -2$. When $x = 0$, $y = 3$, so the y-intercept $c = 3$, at the point (0, 3). Equation: $y = -2x + 3$. Because m is negative, the line slopes downwards from left to right. For $x = 5$: $y = -2 \times 5 + 3 = -10 + 3 = -7$. Answer: $m = -2$, $c = 3$, $y = -2x + 3$, sloping down, and $y = -7$ when $x = 5$.