

Junior Maths - Algebra

Algebraic Notation and Substitution and full-series practice

Student workbook edition

Near-A4 print layout with ruled working space

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book-04-junior-algebra

Junior Maths - Algebra - Table of Contents

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Name: _____

Class: _____

Start date: _____

Worked Solutions Online

This workbook keeps final answers in print so parents and students can check quickly.

For full worked solutions, please visit deepmaths.co.nz and search by book, page and question number.

Direct link: deepmaths.co.nz/worked-solutions

Chapter 1: Algebraic Notation and Substitution

Chapter Goal

Write algebra in standard notation, evaluate expressions and formulae accurately, and begin solving quadratic equations by factorising, formula, and completing the square.

Calculator Policy

This chapter is designed as non-calculator practice. A calculator may be used after finishing to check arithmetic, not to replace written substitution.

Quick Notes - Page 1

1. Letters stand for numbers

A letter such as x , a , or n can represent a number. The value may be given in the question, or it may stay unknown.

2. Multiplication is written compactly

In algebra, write $3 \times x$ as $3x$, and write $a \times b$ as ab .

Put the number first:

$$x \times 7 = 7x$$

Repeated factors can be written using powers:

$$x \times x = x^2$$

3. Division can be written as a fraction

$$x \div 5 = \frac{x}{5}$$

This keeps the expression neat and easier to substitute into later.

Quick Notes - Page 2

4. Substitution means replace the letter

To evaluate $2x + 5$ when $x = 4$, replace x with 4:

$$2(4) + 5 = 13$$

5. Use brackets for negative values

If $x = -3$, then $x^2 = (-3)^2 = 9$. Brackets help protect the negative sign.

6. Follow order of operations

Calculate brackets and powers before multiplication and addition.

7. Formulae work the same way

If $P = 2l + 2w$, $l = 8$, and $w = 5$, then

$$P = 2(8) + 2(5) = 26$$

Quick Notes - Page 3

8. Factorising solves some quadratic equations

If a quadratic is written as a product equal to zero, set each factor equal to zero:

$$(x - 2)(x + 5) = 0 \Rightarrow x = 2 \text{ or } x = -5$$

9. The quadratic formula works for any quadratic

For $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Use exact surd answers unless a decimal is requested.

10. Completing the square rewrites the quadratic

For example, $x^2 + 6x + 5 = 0$ becomes

$$(x + 3)^2 = 4$$

so $x = -1$ or $x = -5$.

Worked Examples

Example 1

Write $6 \times a$ in algebraic notation.

Solution: $6 \times a = 6a$.

Example 2

Write $p \times p \times q$ in algebraic notation.

Solution: $p \times p \times q = p^2q$.

Example 3

Evaluate $3x + 4$ when $x = 5$.

Solution: $3(5) + 4 = 15 + 4 = 19$.

Example 4

Evaluate $x^2 - 2x$ when $x = -4$.

Solution: $(-4)^2 - 2(-4) = 16 + 8 = 24$.

Example 5

Use $A = \frac{1}{2}bh$ to find A when $b = 12$ and $h = 7$.

Solution: $A = \frac{1}{2} \times 12 \times 7 = 42$.

Example 6

Write an expression for 9 less than twice n , then evaluate it when $n = 10$.

Solution: The expression is $2n - 9$. When $n = 10$, $2(10) - 9 = 11$.

Example 7

Solve $x^2 - x - 12 = 0$ by factorising.

Solution: $x^2 - x - 12 = (x - 4)(x + 3)$, so $x = 4$ or $x = -3$.

Example 8

Use the quadratic formula to solve $x^2 + 2x - 3 = 0$.

Solution: $x = \frac{-2 \pm \sqrt{2^2 - 4(1)(-3)}}{2} = \frac{-2 \pm 4}{2}$, so $x = 1$ or $x = -3$.

Example 9

Solve $x^2 - 6x + 5 = 0$ by completing the square.

Solution: $(x - 3)^2 = 4$, so $x = 3 \pm 2$, giving $x = 1$ or $x = 5$.

Skill Practice

1. Write without the multiplication sign: $3 \times a$.

2. Write without the multiplication sign: $b \times 7$.

3. Write without the multiplication sign: $1 \times x$.

4. Write without the multiplication sign: $m \times m$.

5. Write without the multiplication sign: $2 \times p \times q$.

6. Write without the multiplication sign: $5 \times r \times r$.

7. Write without the multiplication sign: $s \times t \times 4$.

8. Write without the multiplication sign: $y \div 3$.

9. Write without the multiplication sign: $8 \times x \times y$.

10. Write without the multiplication sign: $a \times b \times c$.

11. Write without the multiplication sign: $6 \times n \times n \times n$.

12. Write without the multiplication sign: $d \div 5$.

13. Write without the multiplication sign: $9 \times h + 2 \times h$.

14. Write without the multiplication sign: $k \times 10 - 3 \times k$.

15. Write without the multiplication sign: $u \times v \times v$.

16. Write without the multiplication sign: $12 \times x \div 5$.

17. Evaluate $2x + 5$ when $x = 4$.

18. Evaluate $3x - 7$ when $x = 6$.

19. Evaluate $5a + 2$ when $a = 3$.

20. Evaluate $4b - 9$ when $b = 5$.

21. Evaluate $x^2 + 3$ when $x = 7$.

22. Evaluate $2y^2$ when $y = 5$.

23. Evaluate $3p + 4q$ when $p = 2, q = 5$.

24. Evaluate $6m - n$ when $m = 4, n = 7$.

25. Evaluate $ab + 5$ when $a = 6, b = 3$.

26. Evaluate $2(a + b)$ when $a = 5, b = 8$.

27. Evaluate $4x + 3y$ when $x = 7, y = 2$.

28. Evaluate $10 - c^2$ when $c = 3$.

29. Evaluate $\frac{x}{2} + 6$ when $x = 14$.

30. Evaluate $\frac{3t}{4}$ when $t = 8$.

31. Evaluate $5(r - 2)$ when $r = 9$.

32. Evaluate $2u^2 + 1$ when $u = 6$.

33. Evaluate $7g - 2h$ when $g = 5, h = 4$.

34. Evaluate $\frac{a+b}{3}$ when $a = 10, b = 8$.

35. Evaluate $c^2 - d$ when $c = 9, d = 11$.

36. Evaluate $2xy + 3$ when $x = 4, y = 6$.

37. Evaluate $x^2 + y^2$ when $x = 8, y = 6$.

38. Evaluate $9 - k$ when $k = 15$.

39. Evaluate $2x + 9$ when $x = -3$.

40. Evaluate $5 - x$ when $x = -4$.

41. Evaluate $x^2 + 1$ when $x = -5$.

42. Evaluate $3a - 2$ when $a = -6$.

43. Evaluate $4 - b^2$ when $b = -3$.

44. Evaluate $2m + n$ when $m = -4, n = 7$.

45. Evaluate $pq - 3$ when $p = -2, q = 8$.

46. Evaluate $3x^2 - 2x$ when $x = -2$.

47. Evaluate $a - b$ when $a = -7, b = -10$.

48. Evaluate $2(a + 5)$ when $a = -9$.

49. Evaluate $\frac{x}{3} - 4$ when $x = -12$.

50. Evaluate $-2y + 6$ when $y = -5$.

51. Evaluate $u^2 - v$ when $u = -4, v = 9$.

52. Evaluate $3ab$ when $a = -3, b = -5$.

53. Evaluate $2x - y^2$ when $x = -1, y = -4$.

54. Evaluate $5 - 2k^2$ when $k = -2$.

55. Evaluate $\frac{a-b}{2}$ when $a = -3, b = 5$.

56. Evaluate $-x^2 + 4x$ when $x = -3$.

57. Use the formula $P = 2l + 2w$ to find the value when $l = 8, w = 5$.

58. Use the formula $A = bh$ to find the value when $b = 12, h = 7$.

59. Use the formula $C = 4s$ to find the value when $s = 9$.

60. Use the formula $V = lwh$ to find the value when $l = 4, w = 5, h = 6$.

61. Use the formula $F = 3n + 2$ to find the value when $n = 11$.

62. Use the formula $T = 5p - 4$ to find the value when $p = 6$.

63. Use the formula $A = \frac{1}{2}bh$ to find the value when $b = 10, h = 9$.

64. Use the formula $P = 4x + 6$ to find the value when $x = 7$.

65. Use the formula $S = 2a^2$ to find the value when $a = 6$.

66. Use the formula $M = 3r + s$ to find the value when $r = 8, s = 5$.

67. Use the formula $D = rt$ to find the value when $r = 65, t = 3$.

68. Use the formula $Q = \frac{m}{5} + 2$ to find the value when $m = 30$.

69. Use the formula $E = 2x^2 + 3x$ to find the value when $x = 4$.

70. Use the formula $N = a^2 - b^2$ to find the value when $a = 9, b = 4$.

71. A notebook costs n dollars and delivery costs 5 dollars. Write an expression for the total cost.

72. A length of x cm is tripled. Write an expression for the new length.

73. A student has p points and spends 7 points. Write an expression for the points left.

74. Four identical pens each cost y dollars. Write an expression for the total cost.

75. A rope of length m metres is cut exactly in half. Write an expression for one piece.

76. A square has side length t cm. Write an expression for its area.

77. A quiz gives 3 points for each correct answer and 2 bonus points. Write an expression for a correct answers.

78. A number b is doubled and then 6 is subtracted. Write the expression.

79. A box has x red counters and y blue counters. Write an expression for the total number of counters.

80. A mass of q grams has 9 grams removed. Write an expression for the mass left.

Mixed Review

1. Write $4 \times x \times x$ in algebraic notation, then evaluate it when $x = 3$.

2. Evaluate $2x^2 + 3x - 5$ when $x = 4$.

3. A rectangle has length $l = 13$ and width $w = 6$. Use $P = 2l + 2w$ to find its perimeter.

4. Evaluate $x^2 - 4x$ when $x = -3$.

5. Write an expression for three less than $5n$, then evaluate it when $n = 8$.

6. Evaluate $3a + 2b$ when $a = 7$ and $b = -5$.

7. Use $A = \frac{1}{2}bh$ to find A when $b = 16$ and $h = 7$.

8. Evaluate $\frac{2x+y}{3}$ when $x = 5$ and $y = 11$.

9. A ticket costs d dollars. Write the cost of 6 tickets plus a booking fee of 4 dollars, then find the cost when $d = 9$.

10. Evaluate $2p^2 - q^2$ when $p = -4$ and $q = 3$.

11. Use $S = 5n(n + 1)$ to find S when $n = 6$.

12. Write $a \times b \times b \times c$ in algebraic notation, then state the value when $a = 2$, $b = 3$, and $c = 5$.

13. Evaluate $-3x^2 + 2x + 1$ when $x = -2$.

14. A number r is doubled, then 11 is added. Write the expression and evaluate it when $r = -6$.

15. The formula $C = 12 + 4m$ gives a club cost in dollars. Find C when $m = 15$, then explain what the 12 could represent.

16. When $x = 5$, which is larger: $3x^2$ or $(3x)^2$? Give both values.

17. Evaluate $\frac{a^2-b}{a+b}$ when $a = 6$ and $b = 3$.

18. Sam has p pencils. Mia has twice as many as Sam and then buys 5 more. Write Mia's total and find it when $p = 14$.

19. Evaluate $4(2x - 3) - x^2$ when $x = -1$.

20. Use $V = x^3 + 2x$ to find V when $x = -3$.

Challenge Questions

1. If $x = -2$ and $y = 5$, evaluate $3x^2 - 2xy + y$.

2. A rectangle has width w . Its length is 7 more than twice its width. Write an expression for its perimeter, then find the perimeter when $w = 6$.

3. Evaluate $(2a - b)^2 - ab$ when $a = 3$ and $b = -4$.

4. For $n = -3$, find the values of $A = 2n^2 + 5n$ and $B = (2n)^2 + 5n$. Which is greater?

5. The expression $4x + 7$ has value 31. Find x .

6. Find two different values of t that make $t^2 + 4 = 29$.

7. Evaluate $2(x + y)^2 - 3xy$ when $x = -1$ and $y = 4$.

8. Write an expression using k that gives 10 when $k = 2$ and 25 when $k = 5$.

9. Use $R = \frac{3a-b}{2}$ to find R when $a = -4$ and $b = 10$.

10. A sequence rule is $T = 3n^2 - n$. Find T for $n = 1$, $n = 2$, and $n = 3$, then describe the pattern in the answers.

11. Evaluate $(x - 2)(x + 5)$ when $x = -3$.

12. If $x^2 + px + 12 = (x + 3)(x + 4)$, find p .

13. Show that $x = 2$ and $x = 3$ both make $x^2 - 5x + 6 = 0$.

14. Find p if $x = 2$ makes $x^2 + px - 10 = 0$.

15. Find q if $x = -5$ makes $x^2 + 2x + q = 0$.

16. Find two integers with sum 1 and product -20 .

17. If $(x + a)(x - 2) = x^2 + 5x - 14$, find a .

18. Solve $t^2 = 49$.

Quadratic Equation Practice

Use exact answers. Leave surds in simplest exact form where needed.

A. Solving by Factorising

1. Solve by factorising: $x^2 + 7x + 12 = 0$.

2. Solve by factorising: $x^2 - 5x + 6 = 0$.

3. Solve by factorising: $x^2 + x - 20 = 0$.

4. Solve by factorising: $x^2 - 9 = 0$.

5. Solve by factorising: $2x^2 + 7x + 3 = 0$.

6. Solve by factorising: $3x^2 - 11x + 6 = 0$.

7. Solve by factorising: $x^2 - 2x - 15 = 0$.

8. Solve by factorising: $x^2 + 4x - 21 = 0$.

9. Solve by factorising: $4x^2 - 25 = 0$.

10. Solve by factorising: $2x^2 - x - 15 = 0$.

11. Solve by factorising: $6x^2 + x - 2 = 0$.

12. Solve by factorising: $5x^2 - 20 = 0$.

13. Solve by factorising: $x^2 - 8x + 16 = 0$.

14. Solve by factorising: $9x^2 + 12x + 4 = 0$.

15. Solve by factorising: $x^2 + 10x + 21 = 0$.

16. Solve by factorising: $x^2 - 13x + 40 = 0$.

17. Solve by factorising: $2x^2 + 5x - 12 = 0$.

18. Solve by factorising: $4x^2 + 4x - 15 = 0$.

19. Solve by factorising: $3x^2 + 10x + 8 = 0$.

20. Solve by factorising: $6x^2 - 17x + 12 = 0$.

21. Solve: $(x - 2)(x + 7) = 0$.

22. Solve: $x(x - 6) = 0$.

23. Solve: $(2x + 1)(x - 5) = 0$.

24. Solve: $3x(x + 4) = 0$.

B. Using the Quadratic Formula

25. Use the quadratic formula to solve $x^2 + 2x - 1 = 0$.

26. Use the quadratic formula to solve $x^2 - 4x + 1 = 0$.

27. Use the quadratic formula to solve $x^2 + 6x + 5 = 0$.

28. Use the quadratic formula to solve $2x^2 + 3x - 2 = 0$.

29. Use the quadratic formula to solve $3x^2 - 2x - 1 = 0$.

30. Use the quadratic formula to solve $x^2 + x - 1 = 0$.

31. Use the quadratic formula to solve $2x^2 - 4x - 3 = 0$.

32. Use the quadratic formula to solve $3x^2 + 5x - 2 = 0$.

33. Use the quadratic formula to solve $5x^2 - 6x + 1 = 0$.

34. Use the quadratic formula to solve $2x^2 + 2x - 7 = 0$.

35. Use the quadratic formula to solve $4x^2 - 4x - 3 = 0$.

36. Use the quadratic formula to solve $x^2 - 3x - 2 = 0$.

37. Use the quadratic formula to solve $3x^2 + 4x + 1 = 0$.

38. Use the quadratic formula to solve $2x^2 - 5x + 1 = 0$.

39. Use the quadratic formula to solve $x^2 + 8x + 10 = 0$.

40. Use the quadratic formula to solve $5x^2 + 2x - 1 = 0$.

41. Use the quadratic formula to solve $4x^2 + 12x + 5 = 0$.

42. Use the quadratic formula to solve $x^2 - 2x - 5 = 0$.

C. Completing the Square

43. Solve by completing the square: $x^2 + 6x + 5 = 0$.

44. Solve by completing the square: $x^2 - 10x + 21 = 0$.

45. Solve by completing the square: $x^2 + 4x - 1 = 0$.

46. Solve by completing the square: $x^2 - 8x + 7 = 0$.

47. Solve by completing the square: $x^2 + 2x - 8 = 0$.

48. Solve by completing the square: $x^2 - 6x - 4 = 0$.

49. Solve by completing the square: $x^2 + 12x + 20 = 0$.

50. Solve by completing the square: $x^2 - 4x - 7 = 0$.

51. Solve by completing the square: $2x^2 + 8x + 3 = 0$.

52. Solve by completing the square: $3x^2 - 12x + 6 = 0$.

53. Solve by completing the square: $4x^2 + 16x + 7 = 0$.

54. Solve by completing the square: $2x^2 - 12x + 5 = 0$.

55. Solve by completing the square: $x^2 + 14x + 45 = 0$.

56. Solve by completing the square: $x^2 - 2x - 3 = 0$.

57. Solve by completing the square: $x^2 + 5x + 2 = 0$.

58. Solve by completing the square: $x^2 - 7x + 6 = 0$.

59. Solve by completing the square: $2x^2 + 4x - 9 = 0$.

60. Solve by completing the square: $5x^2 - 10x - 3 = 0$.

Equation Application Practice

For each question, define the variable, set up an equation, and solve it. Write a sentence answer when the context needs one.

A. One-Step and Multi-Step Contexts

1. A number is multiplied by 3 and then 7 is added. The result is 34. Find the number.

2. Leila buys 4 identical notebooks and a pen costing 6 dollars. The total cost is 30 dollars. Find the cost of one notebook.

3. A 50 cm ribbon is cut into two equal pieces with 8 cm left over. Find the length of each equal piece.

4. Omar has 5 more stickers than Kai. Together they have 43 stickers. Find how many stickers each person has.

5. Three consecutive integers have a sum of 72. Find the integers.

6. A rectangle has perimeter 46 cm. Its length is 5 cm more than its width. Find the length and width.

7. A taxi fare is 4 dollars plus 2.50 dollars for each kilometre. The fare is 24 dollars. Find the distance travelled.

8. Diego is 4 years older than twice Nina's age. Their ages add to 34. Find both ages.

9. A class has 6 more girls than boys. There are 30 students altogether. Find the number of boys and girls.

10. Five times a number minus 13 is 42. Find the number.

11. A bag has blue counters and red counters. The number of blue counters is 3 times the number of red counters. There are 44 counters altogether. Find the number of each colour.

12. Seven identical pencils and a ruler costing 2 dollars cost 9.70 dollars altogether. Find the cost of one pencil.

13. Sarah runs 2 km more than half of Jae's distance. Together they run 17 km. How far does each person run?

14. A number is decreased by 9 and the result is then doubled. The final result is 26. Find the number.

15. Miri spends $\frac{3}{5}$ of her money and has 18 dollars left. How much money did she have at first?

16. A rectangle has width 6 cm and area 78 cm^2 . Find its length.

17. A phone plan costs 12 dollars plus 0.20 dollars for each text message. The total bill is 23.20 dollars. How many text messages were sent?

18. Two angles on a straight line are x° and $(3x + 20)^\circ$. Find both angles.

19. When 4 is subtracted from a number and the result is divided by 5, the answer is 9. Find the number.

20. Three equal packs and 12 loose cards contain 87 cards altogether. Find the number of cards in each pack.

B. Building Equations from More Detailed Information

21. The sum of two numbers is 58. The larger number is 8 less than twice the smaller number. Find the two numbers.

22. A rectangle has width w cm and length $(3w - 2)$ cm. Its perimeter is 68 cm. Find the dimensions.

23. A triangle has side lengths $x + 5$, $2x + 3$, and $2x + 7$ centimetres. Its perimeter is 65 cm. Find the side lengths.

24. On a bus, the number of children is 5 times the number of adults. There are 72 passengers. Find the number of adults and children.

25. Three large boxes and two small boxes cost 52 dollars altogether. A large box costs 4 dollars more than a small box. Find the cost of each box.

26. Four bags each contain $x - 3$ tokens. Altogether they contain the same number of tokens as two bags of x tokens plus 18 extra tokens. Find x .

27. Lily starts with 13 dollars and saves 5 dollars each week until she has 48 dollars. How many weeks does she save for?

28. A tank contains 120 L of water. It loses 8 L each minute until 56 L remain. How many minutes does this take?

29. The temperature is -6°C . It rises by 3°C each hour until it reaches 15°C . How many hours does this take?

30. A lift starts on floor 3 and goes down 2 floors at each stop. It finishes on floor -9 . How many stops does it make?

31. Hiring a tool costs 18 dollars plus 7 dollars for each hour. The total cost is 67 dollars. How many hours was the tool hired?

32. A number is divided by 4, then 6 is subtracted. The result is -2 . Find the number.

33. Three bags contain x , $x + 6$, and $2x$ marbles. There are 54 marbles altogether. Find the number of marbles in each bag.

34. The mean of x , $x + 4$, and $x + 8$ is 18. Find the three numbers.

35. A recipe uses flour and sugar in the ratio 5 : 2. The total mass is 490 g. Find the mass of flour and the mass of sugar.

36. A journey has two parts. The second part is 18 km less than double the first part. The whole journey is 147 km. Find the length of each part.

C. Quadratic Application Questions

37. A rectangle has width x cm and length $(x + 2)$ cm. Its area is 48 cm^2 . Find the dimensions.

38. Two consecutive positive integers have product 132. Find the integers.

39. A right-angled triangle has perpendicular sides x cm and $(x + 7)$ cm. Its area is 60 cm^2 . Find the two perpendicular side lengths.

40. A rectangle has width x cm and length $(2x + 1)$ cm. Its area is 78 cm^2 . Find the dimensions.

41. A square mat has area 81 cm^2 . Find its side length.

42. A rectangle has length 5 cm more than its width and area 104 cm^2 . Find its dimensions.

43. A positive number is multiplied by 4 less than itself. The product is 45. Find the number.

44. A rectangular garden has width x m and length $(x + 6)$ m. Its area is 135 m^2 . Find the dimensions.

45. Two positive consecutive odd integers have product 143. Find the integers.

46. The height h metres of a toy rocket after t seconds is $h = -t^2 + 8t + 9$. At what times is the height 24 m?

47. A rectangle has perimeter 34 cm and area 60 cm^2 . Find its dimensions.

48. Two positive numbers differ by 6 and have product 72. Find the numbers.

Fractional Algebra and Fractional Equation Practice

Show enough working to make each cancellation or equation step clear. State any rejected value if a context cannot use it.

A. Simplifying Fractional Algebraic Expressions

Simplify each expression.

1. $\frac{6x}{9}$

2. $\frac{15a}{20}$

3. $\frac{12x^2}{8x}$

4. $\frac{18ab}{24a}$

5. $\frac{x^2+5x}{x}$

6. $\frac{3a^2-6a}{3a}$

7. $\frac{4x^2+8x}{4x}$

8. $\frac{15pq^2}{5pq}$

9. $\frac{6x+12}{6}$

10. $\frac{10p-15}{5}$

11. $\frac{14y^2}{21y}$

12. $\frac{8m^2+12m}{4m}$

13. $\frac{x^2-9}{x-3}$

14. $\frac{x^2+7x+10}{x+5}$

15. $\frac{x^2-16}{x-4}$

16. $\frac{x^2-25}{x+5}$

17. $\frac{x^2+2x-8}{x+4}$

18. $\frac{x^2-x-12}{x-4}$

19. $\frac{x^2+6x+9}{x+3}$

20. $\frac{x^2-7x+12}{x-3}$

21. $\frac{2x^2+7x+3}{2x+1}$

22. $\frac{3x^2+10x+3}{3x+1}$

23. $\frac{4x^2-9}{2x-3}$

24. $\frac{9x^2-16}{3x+4}$

25. $\frac{x^2+4x+4}{x+2}$

26. $\frac{6x^2-9x}{3x}$

27. $\frac{8a^2-2a}{2a}$

28. $\frac{12m^2n}{18mn}$

29. $\frac{5x^2-20x}{5x}$

30. $\frac{x^2-2x-15}{x-5}$

31. $\frac{3x^2-12}{3(x-2)}$

32. $\frac{x^2-1}{x+1}$

B. Operations with Algebraic Fractions

Simplify fully.

33. $\frac{x}{3} + \frac{x}{6}$

34. $\frac{5a}{8} - \frac{a}{4}$

35. $\frac{x+1}{4} + \frac{x-3}{4}$

36. $\frac{2x}{3} + \frac{x}{5}$

37. $\frac{3m}{4} - \frac{m}{6}$

38. $\frac{a+2}{3} + \frac{a-1}{6}$

39. $\frac{2x}{3} \times \frac{9}{4x}$

40. $\frac{5a}{6} \times \frac{12}{10a}$

41. $\frac{x^2}{5} \div \frac{x}{10}$

42. $\frac{3p}{4} \div \frac{9p}{8}$

43. $\frac{x^2-4}{x+2} \times \frac{3}{x-2}$

44. $\frac{5x}{12} + \frac{x}{8}$

C. Fractional Equations and Speed-Distance-Time

Set up the equation where needed, then solve.

45. Solve $\frac{24}{x} = 3$.

46. Solve $\frac{6}{x-1} = 2$.

47. Solve $\frac{4}{x+1} = \frac{1}{3}$.

48. Solve $\frac{x+4}{6} = 5$.

49. A car travels 120 km at speed v km/h in 3 hours. Set up an equation and find v .

50. A cyclist travels 45 km at speed s km/h in 1.5 hours. Set up an equation and find s .

51. A bus travels 84 km at speed $(x + 5)$ km/h in 3 hours. Set up an equation and find x , then state the bus speed.

52. A runner completes 18 km at speed $(r - 2)$ km/h in 3 hours. Set up an equation and find r , then state the runner's speed.

53. A 96 km journey takes 1 hour longer at x km/h than at $(x + 8)$ km/h. Set up an equation and find x .

54. A 120 km journey takes 1 hour longer at x km/h than at $(x + 10)$ km/h. Set up an equation and find x .

55. A train travels 150 km. If its speed is increased from x km/h to $(x + 25)$ km/h, the journey time is reduced by 1 hour. Set up an equation and find x .

56. A boat travels 72 km. If its speed is increased from x km/h to $(x + 6)$ km/h, the journey time is reduced by 1 hour. Set up an equation and find x .

Common Mistakes

- Writing $x7$ instead of $7x$.
- Forgetting that $x \times x = x^2$, not $2x$.
- Substituting negative values without brackets.
- Treating $3x^2$ and $(3x)^2$ as the same expression.
- Dividing only one term when the whole numerator is over a denominator.
- Solving a factorised quadratic but writing only one solution.
- Losing the $-b$ or $\pm$ in the quadratic formula.
- Completing the square by adding the full coefficient instead of half the coefficient squared.
- Choosing a variable but forgetting to write the equation before solving.
- Keeping a negative solution when the context needs a positive length, time, or count.
- Cancelling terms across addition instead of factorising first.
- Using $d = s \times t$ incorrectly when the equation needs $t = \frac{d}{s}$.

Progress Tracker

Skill	Not Yet	Getting There	Confident
I can write multiplication in algebraic notation.	☐	☐	☐
I can write division as a fraction.	☐	☐	☐
I can substitute positive values.	☐	☐	☐
I can substitute negative values using brackets.	☐	☐	☐
I can substitute into formulae.	☐	☐	☐
I can write expressions from words and contexts.	☐	☐	☐
I can explain and avoid common notation mistakes.	☐	☐	☐
I can solve quadratic equations by factorising.	☐	☐	☐
I can solve quadratic equations using the formula.	☐	☐	☐
I can solve quadratic equations by completing the square.	☐	☐	☐
I can set up a linear equation from a word problem.	☐	☐	☐
I can set up and solve a quadratic equation from a context.	☐	☐	☐
I can simplify algebraic fractions by factorising and cancelling common factors.	☐	☐	☐
I can set up fractional equations from speed, distance, and time contexts.	☐	☐	☐

Chapter 2: Collecting Like Terms

Chapter Goal

Simplify expressions by combining like terms and respecting signs.

Calculator Policy

This chapter is non-calculator. Check answers by comparing coefficients, not by substituting random values.

Quick Notes - Page 1

Like terms have exactly the same letter part.

- $3x$ and $5x$ are like terms.
- $2a$ and $-7a$ are like terms.
- x and x^2 are not like terms.
- x and y are not like terms.

Quick Notes - Page 2

Collect coefficients and keep the letter part unchanged:

$$4x + 7x = 11x$$

Respect signs:

$$6a - 10a = -4a$$

Constants collect with constants:

$$3x + 5 + 2x - 1 = 5x + 4$$

Worked Examples

Example 1

Simplify $2x + 7x$.

Solution: $2x + 7x = 9x$.

Example 2

Simplify $8a - 3a$.

Solution: $8a - 3a = 5a$.

Example 3

Simplify $4x + 3 + 2x - 5$.

Solution: $4x + 2x = 6x$, and $3 - 5 = -2$, so the answer is $6x - 2$.

Example 4

Simplify $3x + 2y + 5x - y$.

Solution: $3x + 5x = 8x$, and $2y - y = y$, so the answer is $8x + y$.

Example 5

Simplify $2x^2 + 3x + 5x^2 - x$.

Solution: $2x^2 + 5x^2 = 7x^2$, and $3x - x = 2x$, so the answer is $7x^2 + 2x$.

Example 6

Simplify $(4a + 3) - (a - 5)$.

Solution: $4a + 3 - a + 5 = 3a + 8$.

Progress Tracker

Section	Questions	Completed	Correct	Retry
Skill Practice	63	[]	___ / 63	[]
Exam-Style Structured Practice	21	[]	___ / 21	[]
Mixed Review	11	[]	___ / 11	[]
Challenge Questions	11	[]	___ / 11	[]

Skill Practice

1. Simplify $2x + 3x$.

2. Simplify $7a + 4a$.

3. Simplify $9m - 2m$.

4. Simplify $5p + p$.

5. Simplify $8y - y$.

6. Simplify $-3x + 5x$.

7. Simplify $6n - 10n$.

8. Simplify $-4a - 3a$.

9. Simplify $12b - 5b$.

10. Simplify $2q - 2q$.

11. Simplify $3x + 4 + 2x + 5$.

12. Simplify $8a - 3 + 2a + 7$.

13. Simplify $5m + 9 - 2m - 4$.

14. Simplify $-6p + 8 + 10p - 3$.

15. Simplify $7y - 12 - 9y + 20$.

16. Simplify $4n + 3 - 4n + 6$.

17. Simplify $11b - 5 - 3b - 2$.

18. Simplify $-2q + 10 - 5q - 1$.

19. Simplify $6x - 7 - 6x + 4$.

20. Simplify $9a + 1 + a - 11$.

21. Simplify $2x + 3y + 4x - y$.

22. Simplify $5a - 2b + 3a + 7b$.

23. Simplify $-4m + 6n + 9m - 2n$.

24. Simplify $8p + 3q - 5p - 6q$.

25. Simplify $-3x - 4y + 10x + y$.

26. Simplify $12a - 7b - 8a + 2b$.

27. Simplify $6m + 5n - 6m + 4n$.

28. Simplify $-9p + 11q + 4p - 3q$.

29. Simplify $2x + 5y - 7x - 5y$.

30. Simplify $3a + 4b + 5a - 9b$.

31. Simplify $3x^2 + 2x + 5x^2 - x$.

32. Simplify $7a^2 - 3a - 2a^2 + 6a$.

33. Simplify $4p^2 + 5p - 9p + p^2$.

34. Simplify $-2x^2 + 8x + 6x^2 - 3x$.

35. Simplify $5xy + 3x - 2xy + 4x$.

36. Simplify $9x^2 - 4 - 9x^2 + 7$.

37. Simplify $6a^2 + 5a - a^2 - 8a$.

38. Simplify $-3p^2 + 2p - 4p^2 - 5p$.

39. Simplify $3x + 2y + 5x - y$.

40. Simplify $4a - 3b - a - b$.

41. Simplify $6m + 5 - 2m - 9$.

42. Simplify $-5p + 4q + 8p + 2q$.

43. Simplify $7x - 2y - 3x + 6y$.

44. Simplify $9a + 4 - 2a - 10$.

45. Simplify $-4n + 3k - 6n - 5k$.

46. Simplify $2x + 3 + 4x - 5$.

47. Simplify $x + 3 + x + 3 + 2x - 1$.

48. Simplify $4x - 2x + 5 - 9$.

49. Simplify $3a + 2b - 4 + 5a - b + 7$.

50. Simplify $3x + 2y + 4x + 5y$.

51. Simplify $2n + 3 + n - 5 + 4n + 1$.

52. Simplify $5x + 2 - 3x + 6$.

53. Simplify $6m - 2n - 4m + 8n$.

54. Simplify $11p - 4 - 5p + 9$.

55. Simplify $2x^2 + 3x + 5x^2 - 7x$.

56. Simplify $9x - 4y - 3x + 7y + 5$.

57. Simplify $4a^2 - 3a + 2a^2 + 8a - 6$.

58. Simplify $7p - 2q + 5 - 3p + 6q - 9$.

59. Simplify $5m^2 + 2m - 8 + 3m^2 - 7m + 1$.

60. Simplify $4x + 3y - 2x + 5 - y$.

61. Simplify $10a - 3b + 4 - 6a + 8b - 11$.

62. Simplify $3r^2 - 5r + 2 + 4r - 6r^2 + 9$.

63. Simplify $2x + 3y - 4z + 5x - y + 6z$.

Exam-Style Structured Practice

1. Simplify $3x + 5 + 2x - 1$, then evaluate the result when $x = 4$. [4]

2. A triangle has sides $x + 2$, $2x - 1$, and $x + 5$. Find a simplified expression for its perimeter. [4]

3. A rectangle has length $3x + 2$ and width $x + 5$. Find a simplified expression for its perimeter. [5]

4. Simplify $(2a + 3b - 4) + (5a - b + 7)$. [4]

5. Simplify $(8m + 3) - (2m - 5)$. [4]

6. Simplify $2x^2 + 3x + 5x^2 - 4x + 6$. [4]

7. Find k if $3x + kx = 11x$. [3]

8. A student says $2x + 3y = 5xy$. Explain the error and write the simplified expression. [4]

9. A triangle has sides $3a + b$, $2a - b + 4$, and $a + 2b - 1$. Find its perimeter in simplest form. [5]

10. An algebra tile model has four x -tiles, two negative x -tiles, five unit tiles, and nine negative unit tiles. Write the simplified expression. [4]

11. Simplify $-3a + 4b + 7a - 9b - 2$. [4]

12. One order has 3 adult tickets costing x dollars each and 2 child tickets costing y dollars each. Another order has 4 adult tickets and 5 child tickets. Write a simplified expression for the total cost. [5]

13. A rectangle has length $2x + 3$ and width $x - 1$. Find its perimeter in simplest form. [5]

14. Simplify $4x - 2 + 3x + 5$, then evaluate when $x = 2$. [4]

15. Simplify $A = 3x + 2y + x - y$ and $B = 5x + y - x$. Are A and B equivalent? [5]

16. Find the expression that must be added to $3x + 2y$ to make $8x - y$. [4]

17. Find the sum of $2n + 3$, $n - 5$, and $4n + 1$. [4]

18. Simplify $2x^2 + 3x - 4 + 5x^2 - 7x + 1$. [5]

19. Which terms can be combined in $4p + 3q - 2p + 5q - 6$, and what is the simplified expression? [5]

20. The sides of a quadrilateral are $x + 2$, $2x + 3$, $3x - 4$, and $x - 1$. Find its perimeter in simplest form. [5]

21. Find a and b if $ax + by + 2x - 3y = 9x + 5y$. [5]

Mixed Review

1. Write $4 \times a$ in algebraic notation.

2. Evaluate $3x + 2$ when $x = 5$.

3. Simplify $2x + 5x$.

4. Evaluate $4a - 3$ when $a = -2$.

5. Write $b \times b \times 3$ in algebraic notation.

6. Simplify $3m + 2n - m + n$.

7. Evaluate $x^2 + 2x$ when $x = 3$.

8. Simplify $7p - 4 + p - 6$.

9. Use $P = 2l + 2w$ to find P when $l = 5$ and $w = 3$.

10. Simplify $5a + 2b - 3a + 4b$.

11. Write an expression for 6 more than n .

Challenge Questions

1. Find a and b if $ax + 3y + 4x + by = 10x - y$.

2. A rectangle has length $2x + y + 3$ and width $x + 2y - 1$. Find its perimeter in simplest form.

3. The expressions $2n + 5$, $3n - 4$, and $-n + 7$ are added. Simplify the sum, then evaluate it when $n = -2$.

4. A student simplifies $3x^2 + 2x + 5x^2 - 7x$ to $3x^2$. Write the correct simplification and explain the error.

5. Find k if $4x + kx - 9x = 0$ for all values of x .

6. The sum of two expressions is $9a - 2b + 5$. One expression is $4a + 3b - 1$. Find the other expression.

7. The four sides of a quadrilateral are $x + 2y$, $3x - y$, $2x + 5$, and $y - 1$. Find the perimeter in simplest form.

8. Simplify $2p^2 - 3p + 4 + 5p - 7p^2 - 9$.

9. If $A = 4x - 3y + 8$ and $B = -2x + 5y - 6$, simplify $2A - B$.

10. The five sides of a shape are $2x + y$, $x - 3y + 4$, $4x + 2$, $-x + y - 1$, and $3y + 5$. Find the perimeter in simplest form.

11. Find a , b , and c if $ax^2 + bx + c + 3x^2 - 2x + 5 = 8x^2 + 7x - 4$.

Common Mistakes

- Combining x and y terms.
- Combining x and x^2 terms.

- Losing negative signs when moving across an expression.
- Writing $2x + 3y = 5xy$.
- Forgetting to collect constants.

Chapter 3: Expanding Brackets

Chapter Goal

Use the distributive law with positive and negative terms.

Calculator Policy

This chapter is non-calculator. Check expansion by multiplying every term inside the bracket.

Quick Notes - Page 1

Expanding means removing brackets by multiplication.

$$3(x + 4) = 3x + 12$$

The outside number multiplies every term inside the bracket.

Quick Notes - Page 2

Negative signs matter:

$$-2(x - 5) = -2x + 10$$

If a letter is outside the bracket, multiply the letter part as well:

$$x(x + 3) = x^2 + 3x$$

Worked Examples

Example 1

Expand $4(x + 5)$.

Solution: $4(x + 5) = 4x + 20$.

Example 2

Expand $3(2x - 7)$.

Solution: $3(2x - 7) = 6x - 21$.

Example 3

Expand $-2(x + 6)$.

Solution: $-2(x + 6) = -2x - 12$.

Example 4

Expand $-3(x - 4)$.

Solution: $-3(x - 4) = -3x + 12$.

Example 5

Expand $x(x + 8)$.

Solution: $x(x + 8) = x^2 + 8x$.

Example 6

Expand and simplify $2(x + 3) + 5x$.

Solution: $2x + 6 + 5x = 7x + 6$.

Progress Tracker

Section	Questions	Completed	Correct	Retry
Skill Practice	63	[]	___ / 63	[]
Exam-Style Structured Practice	21	[]	___ / 21	[]
Mixed Review	11	[]	___ / 11	[]
Challenge Questions	11	[]	___ / 11	[]

Skill Practice

1. Expand $2(x + 3)$.

2. Expand $3(x + 5)$.

3. Expand $4(a + 2)$.

4. Expand $5(n + 1)$.

5. Expand $6(p + 4)$.

6. Expand $7(y - 2)$.

7. Expand $8(m - 3)$.

8. Expand $3(2x + 1)$.

9. Expand $4(3a + 2)$.

10. Expand $5(2p - 3)$.

11. Expand $2(4y - 7)$.

12. Expand $6(3n + 5)$.

13. Expand $9(x - 4)$.

14. Expand $10(a + 6)$.

15. Expand $3(5m - 2)$.

16. Expand $-2(x + 3)$.

17. Expand $-3(a - 4)$.

18. Expand $-4(2x + 5)$.

19. Expand $-5(3y - 2)$.

20. Expand $2(-x + 7)$.

21. Expand $3(-2a - 5)$.

22. Expand $-2(-3m + 4)$.

23. Expand $-6(-p - 3)$.

24. Expand $-(x - 8)$.

25. Expand $-3(4n + 1)$.

26. Expand $x(x + 3)$.

27. Expand $x(x - 5)$.

28. Expand $2x(x + 4)$.

29. Expand $3x(2x - 1)$.

30. Expand $-x(x + 2)$.

31. Expand $-2x(x - 3)$.

32. Expand $a(a + 6)$.

33. Expand $4a(a - 2)$.

34. Expand $p(3p + 5)$.

35. Expand $-3p(2p - 4)$.

36. Expand and simplify $2(x + 3) + 5x$.

37. Expand and simplify $3(a - 2) + 4a$.

38. Expand and simplify $5(y + 1) - 2y$.

39. Expand and simplify $4(2x - 3) + x$.

40. Expand and simplify $2(3m + 4) - m$.

41. Expand and simplify $-2(x - 5) + 3x$.

42. Expand and simplify $6(a + 2) - 4a$.

43. Expand and simplify $-3(2p + 1) + p$.

44. Expand and simplify $5(n - 4) + 2(n + 3)$.

45. Expand and simplify $3(x + 2) - 2(x - 5)$.

46. Four notebooks cost $x + 2$ dollars each. Write the total cost in expanded form.

47. A regular pentagon has side length $x + 3$. Find its perimeter in expanded form.

48. A rectangle has height 6 and width $x + 5$. Find its area in expanded form.

49. A fare is three lots of $x + 7$. Write the expanded expression.

50. Two bags each have mass $y - 4$. Write the total mass in expanded form.

51. A rectangle has length $x + 6$ and width $x + 2$. Find its perimeter in expanded form.

52. A rectangle has length $2x - 1$ and height 5. Find its area in expanded form.

53. Seven groups each contain $a - 3$. Write the total in expanded form.

54. A correction subtracts two lots of $x - 4$. Write this as an expanded expression.

55. An area model has height 3 and width $2x + 5$. Write its area in expanded form.

56. Expand $6(x - 3)$.

57. Expand $-4(2x + 5)$.

58. Expand and simplify $3(2a - 5) - 4(a + 1)$.

59. Expand $5p(p - 2)$.

60. Expand $-3x(2x - 7)$.

61. Expand and simplify $2(3x - 4) + 5(x + 1)$.

62. Expand and simplify $4(y - 2) - 3(2y + 1)$.

63. A rectangle has length $3x - 2$ and width 4. Write its area in expanded form.

Exam-Style Structured Practice

1. Expand $4(x + 7)$, then evaluate the result when $x = 2$. [4]

2. A rectangle has width $x + 3$ and height 8. Find its area in expanded form. [3]

3. A rectangle has length $2x + 5$ and width $x + 1$. Find its perimeter in simplest form. [5]

4. Expand and simplify $3(x + 4) + 2(x - 1)$. [5]

5. Expand and simplify $-2(5x - 3) + 4x$. [5]

6. A student writes $-3(x + 2) = -3x + 6$. Explain the error and give the correct expansion. [4]

7. Expand $2x(x + 5)$. [3]

8. Expand and simplify $x(x + 3) + 2x$. [4]

9. An area model has one side $x + 4$ and the other side 5. Write the expanded area expression. [3]

10. Find k if $k(x + 2) = 5x + 10$. [3]

11. Expand and simplify $4(3a - 2) - 5a$. [5]

12. Expand and simplify $6(2p + 1) - 3(p - 4)$. [5]

13. A triangle has sides $2(x + 1)$, $3(x - 2)$, and $x + 5$. Find its perimeter in simplest form. [5]

14. Expand $-(4x - 7)$. [3]

15. Expand and simplify $2(3x + 4) - 5(x - 2)$. [5]

16. Three tickets cost $x + 4$ dollars each and two tickets cost $x - 1$ dollars each. Find the total cost in simplest form. [5]

17. Expand $5a(2a - 3)$. [4]

18. Expand $-2m(3m + 4)$. [4]

19. Find c if $3(2x + c) = 6x + 21$. [3]

20. Show whether $2(x + 5) + 3x$ and $5x + 10$ are equivalent. [4]

21. Expand and simplify $4(x - 3) - 2(2x + 1)$. [5]

Mixed Review

1. Write $3 \times a$ in algebraic notation.

2. Evaluate $2x + 5$ when $x = 4$.

3. Simplify $4x + 7x$.

4. Expand $3(x + 2)$.

5. Evaluate $x^2 - 3x$ when $x = -2$.

6. Simplify $5a + 2b - 3a + b$.

7. Expand $-2(y - 4)$.

8. Write $p \times p \times 6$ in algebraic notation.

9. Expand $x(x + 6)$.

10. Expand and simplify $2(x + 1) + x$.

11. Write an expression for 5 less than twice n .

Challenge Questions

1. Expand $(x + 3)(x + 4)$.

2. Expand $(x - 5)(x + 2)$.

3. Expand $(2x + 3)(x - 4)$.

4. Find k if $3(x + k) = 3x + 18$.

5. Expand and simplify $2(x + 3) - 3(x - 4)$.

6. A rectangle has side lengths $x + 2$ and $x + 5$. Find its area in expanded form.

7. A student expands $-2(3x - 5)$ as $-6x - 10$. Give the correct expansion and explain the sign error.

8. Expand and simplify $x(x + 4) - 2(x - 3)$.

9. Expand $(x - 6)(x + 5)$.

10. Expand $(3x - 2)(2x + 7)$.

11. Expand and simplify $3(x - 2) - 2(4 - x)$, then evaluate the result when $x = -1$.

Common Mistakes

- Multiplying only the first term inside the bracket.
- Forgetting that a negative multiplier changes signs.
- Writing $x(x + 3) = x + 3x$ instead of $x^2 + 3x$.
- Forgetting to collect like terms after expanding.

- Changing signs inside a bracket without a reason.

Chapter 4: Factorising Expressions

Chapter Goal

Identify common factors and factorise linear and simple quadratic expressions.

Calculator Policy

This chapter is non-calculator. Check factorising by expanding the answer.

Quick Notes - Page 1

Factorising is the reverse of expanding.

$$3x + 12 = 3(x + 4)$$

Take out the highest common factor when possible.

Quick Notes - Page 2

Letters can be common factors:

$$x^2 + 5x = x(x + 5)$$

For simple quadratics, find two numbers that multiply to the constant and add to the coefficient of x :

$$x^2 + 5x + 6 = (x + 2)(x + 3)$$

Worked Examples

Example 1

Factorise $4x + 20$.

Solution: $4x + 20 = 4(x + 5)$.

Example 2

Factorise $6a - 9$.

Solution: $6a - 9 = 3(2a - 3)$.

Example 3

Factorise $x^2 + 7x$.

Solution: $x^2 + 7x = x(x + 7)$.

Example 4

Factorise $-2x - 8$.

Solution: $-2x - 8 = -2(x + 4)$.

Example 5

Factorise $x^2 + 8x + 15$.

Solution: $x^2 + 8x + 15 = (x + 3)(x + 5)$.

Example 6

Factorise $x^2 - 16$.

Solution: $x^2 - 16 = (x - 4)(x + 4)$.

Progress Tracker

Section	Questions	Completed	Correct	Retry
Skill Practice	86	[]	___ / 86	[]
Exam-Style Structured Practice	21	[]	___ / 21	[]
Mixed Review	11	[]	___ / 11	[]
Challenge Questions	8	[]	___ / 8	[]
Year 9 Extension: Vieta's Theorem	10	[]	___ / 10	[]

Skill Practice

1. Factorise $2x + 6$.

2. Factorise $3x + 12$.

3. Factorise $4a - 8$.

4. Factorise $10p + 5$.

5. Factorise $18y - 24$.

6. Factorise $7m + 14$.

7. Factorise $16n + 24$.

8. Factorise $9x - 45$.

9. Factorise $10a + 60$.

10. Factorise $10p - 14$.

11. Factorise $x^2 + 4x$.

12. Factorise $2x^2 + 6x$.

13. Factorise $3a^2 - 12a$.

14. Factorise $8p^2 + 4p$.

15. Factorise $5m^2 - 10m$.

16. Factorise $3y^2 + 7y$.

17. Factorise $6x^2 - 6x$.

18. Factorise $6a^2 + 10a$.

19. Factorise $4n^2 + 12n$.

20. Factorise $6p^2 - 15p$.

21. Factorise $2x + 2y$.

22. Factorise $3a - 3b$.

23. Factorise $8m + 4n$.

24. Factorise $5p + 5q$.

25. Factorise $12x - 18y$.

26. Factorise $7a + 14b$.

27. Factorise $12m + 15n$.

28. Factorise $12p - 2q$.

29. Factorise $15x - 10y$.

30. Factorise $4a + 4b + 8$.

31. Factorise $-2x - 6$.

32. Factorise $-3a + 12$.

33. Factorise $-4x + 20$.

34. Factorise $-5p - 15$.

35. Factorise $-2x^2 + 8x$.

36. Factorise $-3a^2 - 6a$.

37. Factorise $-x^2 + 7x$.

38. Factorise $-6m^2 + 12m$.

39. Factorise $-4p^2 - 20p$.

40. Factorise $-8x - 16y$.

41. Factorise $x^2 + 5x + 6$.

42. Factorise $x^2 + 7x + 10$.

43. Factorise $x^2 + 9x + 20$.

44. Factorise $x^2 + 6x + 8$.

45. Factorise $x^2 - 5x + 6$.

46. Factorise $x^2 - 7x + 12$.

47. Factorise $x^2 - x - 6$.

48. Factorise $x^2 + x - 12$.

49. Factorise $x^2 - 9$.

50. Factorise $x^2 - 16$.

51. Factorise $x^2 + 2x - 15$.

52. Factorise $x^2 - 4x - 12$.

53. Factorise $x^2 + 10x + 21$.

54. Factorise $x^2 - 11x + 30$.

55. Factorise $x^2 - 25$.

56. Factorise $x^2 - 14x + 49$.

57. Factorise $x^2 + 12x + 36$.

58. Factorise $x^2 - 2x - 35$.

59. Factorise $x^2 + 3x - 40$.

60. Factorise $2x^2 + 8x$ fully.

61. Factorise $3x^2 - 27$ fully.

62. Factorise $4x^2 + 20x + 24$ fully.

63. Factorise $6x^2 + 15x$ fully.

64. Factorise $x^2 + 5x - 24$.

65. Factorise $x^2 - 16$.

66. Factorise $2x^2 - 18$ fully.

67. Factorise $x^2 - 3x - 28$.

68. Factorise $3x^2 + 12x + 12$ fully.

69. Factorise $4x^2 - 9$.

70. Factorise $2x^2 + 14x + 24$ fully.

71. Factorise $x^2 - 10x + 21$.

72. Factorise $x^2 + 2x - 48$.

73. Factorise $5x^2 - 20x$ fully.

74. Factorise $x^2 - 81$.

75. Factorise $3x^2 - 12x - 15$ fully.

76. Factorise $2x^2 + 18x + 40$ fully.

77. Factorise $9x^2 - 16$.

78. Factorise $x^2 + x - 72$.

79. Factorise $x^2 - 4x - 45$.

80. Factorise $x^2 + 15x + 54$.

81. Factorise $6x^2 + 30x$ fully.

82. Factorise $2x^2 - 50$ fully.

83. Factorise $x^2 - 121$.

84. Factorise $4x^2 + 4x - 24$ fully.

85. Factorise $3x^2 + 3x - 90$ fully.

86. Factorise $25x^2 - 1$.

Exam-Style Structured Practice

1. Factorise $6x + 18$, then check by expanding your answer. [4]

2. Factorise $12a - 8$ fully. [3]

3. Factorise $x^2 + 9x$. [3]

4. Factorise $5x^2 - 20x$ fully. [4]

5. A rectangle has area $3x + 12$ and height 3. Find its width. [4]

6. Factorise $4x + 4y$. [3]

7. Factorise $6a - 9b$ fully. [4]

8. Factorise $x^2 + 6x + 8$. [4]

9. Factorise $x^2 - 7x + 10$. [4]

10. A student writes $2x + 6 = 2(x + 6)$. Explain the error and give the correct factorisation. [4]

11. Factorise $-3x - 12$ using a negative common factor. [4]

12. Factorise $2x^2 + 10x + 12$ fully. [6]

13. Find k if $4(x + k) = 4x + 28$. [3]

14. A rectangle has area $x^2 + 7x + 12$. Factorise the area expression to find possible side lengths. [5]

15. Factorise $8x + 20$ fully. [3]

16. Factorise $9p^2 - 6p$ fully. [4]

17. Factorise $x^2 - 49$. [4]

18. Factorise $x^2 - x - 20$. [4]

19. Factorise $12m + 18n$ fully. [4]

20. Factorise $5x + 5y + 10$ fully. [4]

21. Factorise $3x + 15$, then evaluate the original expression when $x = 2$. [5]

Mixed Review

1. Write $5 \times a$ in algebraic notation.

2. Simplify $3x + 4x$.

3. Expand $2(x + 5)$.

4. Factorise $2x + 10$.

5. Evaluate $3x - 4$ when $x = 5$.

6. Simplify $5a + 2b - 3a + b$.

7. Expand $-3(y - 2)$.

8. Factorise $x^2 + 4x$.

9. Factorise $x^2 + 3x + 2$.

10. Expand $x(x + 6)$.

11. Write an expression for 4 more than $2n$.

Challenge Questions

1. Factorise $x^2 - 2x - 35$.

2. Factorise $x^2 + 13x + 42$.

3. Factorise $2x^2 + 10x$ fully.

4. Factorise $6x^2 + 9x$ fully.

5. Factorise $x^2 - 64$.

6. Factorise $4x^2 - 36$ fully.

7. Find k if $x^2 + kx + 24 = (x + 3)(x + 8)$.

8. A student says $x^2 + 5x + 6 = x(x + 5) + 6$. Give a fully factorised form and explain why the student's answer is not fully factorised.

Year 9 Extension: Vieta's Theorem

For a quadratic equation

$$x^2 + bx + c = 0,$$

if the roots are r and s , then

$$r + s = -b, \quad rs = c.$$

For $ax^2 + bx + c = 0$, the roots have sum $-\frac{b}{a}$ and product $\frac{c}{a}$. This is useful for checking factorising and building quadratics from roots.

E1. A monic quadratic has roots 3 and 5. Use Vieta's theorem to write the equation.

E2. For $x^2 - 7x + 12 = 0$, state the sum and product of the roots, then find the roots.

E3. Use Vieta's theorem to factorise $x^2 - 9x + 20$.

E4. The roots of $x^2 + kx + 18 = 0$ are 3 and 6. Find k .

E5. A monic quadratic has roots -2 and 7 . Write the equation in the form $x^2 + bx + c = 0$.

E6. For $2x^2 - 10x + 12 = 0$, use Vieta's theorem to state the sum and product of the roots, then find the roots.

E7. A monic quadratic has one root 4 and constant term 28 . Find the other root and write the equation.

E8. A monic quadratic has positive integer roots whose product is 36 and whose difference is 5 . Write the equation.

E9. The roots of $x^2 - 10x + m = 0$ differ by 2 . Find m .

E10. A quadratic $x^2 + px + q = 0$ has roots a and b , where $a + b = -4$ and $ab = -12$. Find p , q , and the two roots.

Common Mistakes

- Taking out 2 from $2x^2 + 6x$ instead of the full common factor $2x$.
- Forgetting to check by expanding.
- Choosing factors that multiply correctly but do not add correctly.
- Leaving an expression only partly factorised.
- Losing a negative sign when taking out a negative factor.
- Using b instead of $-b$ for the sum of roots in $x^2 + bx + c = 0$.
- Forgetting to divide by a when using Vieta's theorem on $ax^2 + bx + c = 0$.

Chapter 5: Linear Equations

Chapter Goal

Solve one-step, two-step, bracketed, and fractional linear equations.

Calculator Policy

This chapter is non-calculator. Check each answer by substituting it into the original equation.

Quick Notes - Page 1

An equation is balanced. Whatever you do to one side, do to the other side.

For $x + 5 = 12$, subtract 5:

$$x = 7$$

For $3x = 18$, divide by 3:

$$x = 6$$

Quick Notes - Page 2

For brackets, expand or divide first:

$$2(x + 3) = 14$$

Divide by 2:

$$x + 3 = 7$$

So $x = 4$.

For variables on both sides, move the smaller variable term first when it helps.

Worked Examples

Example 1

Solve $x + 8 = 15$.

Solution: subtract 8, so $x = 7$.

Example 2

Solve $4x = 28$.

Solution: divide by 4, so $x = 7$.

Example 3

Solve $3x - 5 = 16$.

Solution: $3x = 21$, so $x = 7$.

Example 4

Solve $2(x + 4) = 18$.

Solution: $x + 4 = 9$, so $x = 5$.

Example 5

Solve $5x + 2 = 2x + 20$.

Solution: $3x + 2 = 20$, so $3x = 18$, and $x = 6$.

Example 6

Solve $\frac{x+3}{4} = 5$.

Solution: $x + 3 = 20$, so $x = 17$.

Progress Tracker

Section	Questions	Completed	Correct	Retry
Skill Practice	74	[]	___ / 74	[]
Exam-Style Structured Practice	25	[]	___ / 25	[]
Mixed Review	14	[]	___ / 14	[]
Challenge Questions	12	[]	___ / 12	[]

Skill Practice

1. Solve $x + 3 = 10$.

2. Solve $x + 5 = 17$.

3. Solve $x + 8 = 6$.

4. Solve $x + 9 = 9$.

5. Solve $x - 4 = 11$.

6. Solve $x - 5 = -11$.

7. Solve $x + 10 = 31$.

8. Solve $x - 7 = -3$.

9. Solve $x - 4 = 5$.

10. Solve $x - 11 = -8$.

11. Solve $x - 6 = -11$.

12. Solve $x + 3 = 17$.

13. Solve $x - 8 = -8$.

14. Solve $x + 2 = -5$.

15. Solve $x - 15 = 5$.

16. Solve $6x = 18$.

17. Solve $-4x = -20$.

18. Solve $7x = -14$.

19. Solve $3x = 24$.

20. Solve $-5x = 30$.

21. Solve $11x = 44$.

22. Solve $4x = 28$.

23. Solve $2x = -18$.

24. Solve $\frac{x}{2} = 3$.

25. Solve $\frac{x}{4} = 2$.

26. Solve $\frac{x}{5} = -1$.

27. Solve $\frac{x}{3} = 3$.

28. Solve $\frac{x}{6} = 2$.

29. Solve $\frac{x}{7} = -1$.

30. Solve $\frac{x}{2} = 5$.

31. Solve $2x + 3 = 17$.

32. Solve $3x - 5 = 7$.

33. Solve $4x + 6 = -2$.

34. Solve $5x - 7 = 23$.

35. Solve $-2x + 9 = 3$.

36. Solve $6x + 1 = -23$.

37. Solve $7x - 8 = 27$.

38. Solve $8x + 10 = 10$.

39. Solve $-3x - 2 = -14$.

40. Solve $9x - 6 = -15$.

41. Solve $2x - 11 = 13$.

42. Solve $5x + 15 = 0$.

43. Solve $4x - 9 = 23$.

44. Solve $-6x + 5 = 17$.

45. Solve $3x + 14 = 35$.

46. Solve $10x - 20 = 40$.

47. Solve $12x + 4 = -8$.

48. Solve $-5x - 15 = -30$.

49. Solve $6x - 18 = 36$.

50. Solve $7x + 21 = -14$.

51. Solve $3x + 4 = x + 20$.

52. Solve $5x - 2 = 2x + 10$.

53. Solve $4x + 9 = -x + 24$.

54. Solve $7x - 5 = 3x - 13$.

55. Solve $-2x + 6 = 4x - 24$.

56. Solve $6x + 1 = 2x - 11$.

57. Solve $8x - 7 = 5x - 1$.

58. Solve $-3x + 10 = x - 6$.

59. Solve $9x + 5 = 4x$.

60. Solve $2x - 11 = -3x + 19$.

61. Solve $2(x + 3) = 14$.

62. Solve $3(x - 2) = 15$.

63. Solve $-4(x + 5) = -16$.

64. Solve $5(x - 6) = -20$.

65. Solve $\frac{x+4}{3} = 4$.

66. Solve $\frac{x-2}{5} = 0.2$.

67. Solve $\frac{x+7}{2} = 3$.

68. Solve $\frac{2x+1}{3} = 5$.

69. Solve $\frac{3x-4}{2} = 10$.

70. Solve $4(x - 3) = 2x + 10$.

71. Solve $5 - 2(x + 1) = 17$.

72. Solve $3(2x - 5) = 4x + 9$.

73. Solve $\frac{x-5}{4} + \frac{x+1}{2} = 6$.

74. Solve $7(x - 2) - 3(x + 4) = 10$.

Exam-Style Structured Practice

1. Solve $4x + 7 = 31$. [3]

2. Solve $5x - 9 = 36$. [3]

3. Solve $-3x + 4 = 19$. [4]

4. Solve $2(x + 5) = 28$. [4]

5. Solve $3(x - 4) = 21$. [4]

6. Solve $5x + 7 = 2x + 28$. [5]

7. Solve $8x - 5 = 3x + 20$. [5]

8. Solve $\frac{x+4}{3} = 7$. [4]

9. Solve $\frac{2x-1}{5} = 3$. [5]

10. A number is doubled and 5 is added. The result is 23. Find the number. [4]

11. A rectangle has length $x + 4$ and width x . Its perimeter is 32. Find x . [5]

12. Two angles in a triangle are x and $2x + 30$. The third angle is 60° . Find x . [5]

13. Two consecutive integers have sum 37. Find the smaller integer. [5]

14. Three tickets each cost x dollars and a booking fee of 4 dollars is added. The total is 31 dollars. Find x . [4]

15. Solve $2(x + 3) + x = 24$. [5]

16. Solve $4(x - 2) - x = 19$. [5]

17. Solve $-2(x - 5) = 18$. [4]

18. Solve $\frac{x}{4} + 3 = 9$. [5]

19. Solve $7x - 3 = 4x + 15$. [5]

20. A balance has $2x + 6$ on one side and $x + 15$ on the other. Find x . [4]

21. A rectangle has area 45 cm^2 and width 5 cm. Its length is $x + 2$. Find x . [5]

22. The mean of x , 8, and 13 is 10. Find x . [5]

23. A triangle has sides $x + 1$, $x + 3$, and $2x$. Its perimeter is 32. Find x . [5]

24. Show that $x = 4$ solves $3(x + 2) = 18$. [3]

25. A student solves $2x + 5 = 17$ and writes $2x = 22$. Explain the error and give the correct solution. [4]

Mixed Review

1. Write $6 \times a$ in algebraic notation.

2. Simplify $4x + 9x$.

3. Expand $3(x + 4)$.

4. Factorise $3x + 12$.

5. Solve $x + 7 = 19$.

6. Solve $2x + 3 = 15$.

7. Evaluate $x^2 + 1$ when $x = -3$.

8. Simplify $6a - 2b - a + 5b$.

9. Expand $-2(x - 6)$.

10. Solve $5x = 35$.

11. Factorise $x^2 + 6x$.

12. Solve $3x - 4 = 11$.

13. Write an expression for 4 less than n .

14. Factorise $x^2 + 5x + 6$.

Challenge Questions

1. Solve $\frac{3x-2}{4} = 7$.

2. Solve $2(x + 5) = 3(x - 2) + 7$.

3. Solve $5(2x - 1) = 3(x + 6) + 5$.

4. A number is multiplied by 4, then 9 is subtracted. The result is the same as doubling the number and adding 17. Find the number.

5. A rectangle has length $2x + 3$, width $x - 1$, and perimeter 46. Find x .

6. The mean of $2x$, $x + 4$, and 17 is 13. Find x .

7. Solve $\frac{2(x+3)}{5} = 6$.

8. The expression $3(x + 4)$ has value 45. Find x .

9. A student solves $4(x - 2) = 20$ and gets $x = 3$. Explain the error and give the correct solution.

10. Solve $\frac{3x+5}{2} = 2x - 1$.

11. A number has 3 subtracted, then the result is multiplied by 5. The answer is the same as doubling the original number and adding 18. Find the number.

12. Solve $2(x - 4) + 3(x + 1) = 40$.

Common Mistakes

- Changing one side of the equation but not the other.
- Adding when the inverse operation should be subtracting.
- Dividing before removing a constant in a two-step equation.
- Expanding brackets incorrectly.
- Not checking the solution in the original equation.

Chapter 6: Inequalities

Chapter Goal

Solve and represent simple inequalities on number lines.

Calculator Policy

This chapter is non-calculator. Check answers by testing values on either side of the boundary.

Quick Notes - Page 1

Inequality symbols:

- $<$: less than
- $>$: greater than
- $\leq$: less than or equal to
- $\geq$: greater than or equal to

Strict inequalities use open circles on number lines. Inequalities with equality use closed circles.

Quick Notes - Page 2

Solve inequalities like equations, except:

When multiplying or dividing by a negative number, reverse the inequality sign.

$$-2x < 6 \quad \Rightarrow \quad x > -3$$

Worked Examples

Example 1

Solve $x + 4 < 9$.

Solution: $x < 5$.

Example 2

Solve $3x \geq 12$.

Solution: $x \geq 4$.

Example 3

Solve $-2x < 10$.

Solution: divide by -2 and reverse the sign, so $x > -5$.

Example 4

Solve $2x + 1 \leq 9$.

Solution: $2x \leq 8$, so $x \leq 4$.

Example 5

Describe $x > 3$ on a number line.

Solution: open circle at 3, shade right.

Example 6

Solve $1 < x + 2 \leq 7$.

Solution: subtract 2 from all parts: $-1 < x \leq 5$.

Progress Tracker

Section	Questions	Completed	Correct	Retry
Skill Practice	62	[]	___ / 62	[]
Exam-Style Structured Practice	18	[]	___ / 18	[]
Mixed Review	10	[]	___ / 10	[]
Challenge Questions	10	[]	___ / 10	[]

Skill Practice

1. Write $x > 3$ in words.

2. Write $x \leq -2$ in words.

3. Describe the number line for $x < 4$.

4. Describe the number line for $x \geq 1$.

5. Which symbols include equality?

6. Is $5 > 2$ true or false?

7. Solve $x + 3 < 10$.

8. Solve $x - 5 \geq 2$.

9. Solve $x + 8 \leq 4$.

10. Solve $x - 2 > -6$.

11. Solve $x + 7 \geq 0$.

12. Solve $x - 9 < 3$.

13. Solve $x + 11 > 5$.

14. Solve $x - 4 \leq -10$.

15. Solve $x + 1 < 1$.

16. Solve $x - 6 \geq 6$.

17. Solve $2x < 10$.

18. Solve $3x \geq -12$.

19. Solve $5x \leq 25$.

20. Solve $4x > -8$.

21. Solve $\frac{x}{4} \leq 3$.

22. Solve $\frac{x}{5} > -2$.

23. Solve $\frac{x}{3} \geq 6$.

24. Solve $7x < 0$.

25. Solve $6x \geq 42$.

26. Solve $8x \leq -16$.

27. Solve $-2x < 6$.

28. Solve $-3x \geq 12$.

29. Solve $-x < 5$.

30. Solve $-4x \leq -20$.

31. Solve $-5x > 15$.

32. Solve $-6x \geq -18$.

33. Solve $-\frac{x}{2} < 4$.

34. Solve $-\frac{x}{3} \leq -2$.

35. Solve $2x + 3 < 11$.

36. Solve $3x - 5 \geq 10$.

37. Solve $4x + 6 \leq -2$.

38. Solve $5x - 7 > 18$.

39. Solve $-2x + 4 < 12$.

40. Solve $-3x - 6 \geq 9$.

41. Solve $6x + 1 \geq 25$.

42. Solve $7x - 2 < 19$.

43. Write the inequality shown by an open circle at 2, shaded right.

44. Write the inequality shown by a closed circle at -1 , shaded left.

45. Write the inequality shown by an open circle at 5, shaded left.

46. Write the inequality shown by a closed circle at 0, shaded right.

47. Solve $2x + 5 \leq 17$.

48. Solve $3x - 4 > 11$.

49. Solve $-5x < 20$.

50. Solve $-2x + 7 \geq 15$.

51. Solve $4(x - 1) \leq 20$.

52. Solve $5 - 3x > 14$.

53. Write the inequality shown by a closed circle at 4, shaded left.

54. Write the inequality shown by an open circle at -2 , shaded right.

55. Solve $7x - 9 \leq 26$.

56. Solve $12 - 4x < 0$.

57. Solve $3(x + 2) \geq 2x + 11$.

58. Solve $5 - 2(x - 3) \leq 13$.

59. Write the inequality shown by an open circle at 6 , shaded left.

60. Write the inequality shown by a closed circle at -5 , shaded right.

61. List the integer values satisfying $-2 < x \leq 3$.

62. Solve $4x + 1 > 2x + 9$.

Exam-Style Structured Practice

1. Solve $2x - 5 < -17$ and describe the number line. [5]

2. Solve $3x + 7 \geq -11$ and describe the number line. [5]

3. Solve $-4x + 8 < 20$. [4]

4. Solve $5 - 2x \leq 13$. [4]

5. A value $3x - 5$ is at most -20 . Write and solve an inequality for x . [5]

6. A team starts on -10 points after a penalty. It needs more than 20 points and earns 6 points per win. Find the least whole number of wins needed. [6]

7. A number line has an open circle at -3 and is shaded to the right. Write the inequality. [3]

8. Find the integer solutions of $-5 < 2x + 1 < 7$. [5]

9. List the integer solutions of $-3 \leq x < 2$. [4]

10. Solve $4(x - 2) > 12$. [4]

11. Solve $2(x + 3) \leq x + 10$. [5]

12. Solve $5x - 1 > 2x + 8$. [5]

13. Solve $\frac{x-2}{3} \geq -4$. [4]

14. Solve $-\frac{x}{2} < 6$. [4]

15. A rectangle has length $x + 3$, width x , and perimeter at most 30. Find the possible values of x . [6]

16. The mean of x , -8 , 14 , and 16 is at least 10 . Find the possible values of x . [6]

17. A taxi costs $2d - 4$ dollars after a discount for d kilometres. The fare must be no more than 20 dollars. Find the possible values of d . [5]

18. Solve $3x - 5 < x - 17$. [5]

Mixed Review

1. Write $5 \times a$ in algebraic notation.

2. Simplify $3x + 8x$.

3. Expand $4(x - 2)$.

4. Factorise $4x - 8$.

5. Solve $2x + 5 = 17$.

6. Solve $2x + 5 < 17$.

7. Evaluate $x^2 + 2$ when $x = -3$.

8. Factorise $x^2 + 7x + 10$.

9. Describe $x \leq 4$ on a number line.

10. Solve $3(x + 2) = 18$.

Challenge Questions

1. Solve $3 < 2x + 1 \leq 11$.

2. Solve $-2 \leq 3x - 5 < 10$.

3. Find the integer solutions of $-1 < 2x + 3 \leq 9$.

4. A rectangle has length $x + 4$ and width $2x - 1$. Its perimeter is no more than 50, and the width must be positive. Find the possible values of x .

5. Solve $-3(x - 4) \geq 2x + 7$.

6. Find k if the solution of $kx < 12$ is $x > -4$.

7. Solve $-16 < 3x - 1 \leq 14$.

8. A bank balance after a fee is $4x - 12$ dollars. It must be at least -4 dollars. Write and solve an inequality for x .

9. Solve $-2(x - 3) < x + 12$.

10. Find the integer values of x that satisfy $5x - 7 < -2$ and $x \geq -3$.

Common Mistakes

- Forgetting to reverse the inequality after dividing by a negative.
- Using a closed circle for $<$ or $>$.
- Shading right for less-than statements.
- Ignoring the word "integer" in solution-list questions.
- Solving a context as an equation when the question says "at most" or "more than".

Chapter 7: Formulae and Rearranging

Chapter Goal

Substitute into and rearrange formulae with clear inverse operations.

Calculator Policy

This chapter is non-calculator. Check rearranged formulae by substituting the new subject back into the original formula.

Quick Notes - Page 1

Substitute means replace each letter with its value, then calculate carefully.

For $A = lw$, $l = 8$, and $w = 5$:

$$A = 8 \times 5 = 40$$

Quick Notes - Page 2

To rearrange a formula, use inverse operations until the required letter is alone.

For $y = 3x + 4$:

$$y - 4 = 3x \quad \Rightarrow \quad x = \frac{y - 4}{3}$$

Worked Examples

Example 1

Evaluate $P = 2l + 2w$ when $l = 7$ and $w = 4$.

Solution: $P = 2(7) + 2(4) = 22$.

Example 2

Evaluate $v = u + at$ when $u = 5$, $a = 3$, and $t = 4$.

Solution: $v = 5 + 3(4) = 17$.

Example 3

Make x the subject of $y = x + 8$.

Solution: subtract 8, so $x = y - 8$.

Example 4

Make x the subject of $y = 5x$.

Solution: divide by 5, so $x = \frac{y}{5}$.

Example 5

Make x the subject of $y = 3x + 4$.

Solution: subtract 4, then divide by 3: $x = \frac{y-4}{3}$.

Example 6

Make h the subject of $V = lwh$.

Solution: divide by lw , so $h = \frac{V}{lw}$.

Progress Tracker

Section	Questions	Completed	Correct	Retry
Skill Practice	78	[]	___ / 78	[]
Year 10 Changing Subject Practice	8	[]	___ / 8	[]
Exam-Style Structured Practice	21	[]	___ / 21	[]
Mixed Review	11	[]	___ / 11	[]
Challenge Questions	17	[]	___ / 17	[]

Common Mistakes

- Substituting values but forgetting brackets around negative numbers.
- Dividing only one term when the whole numerator must be divided.
- Moving a term to the other side without changing the operation.
- Rearranging correctly but not checking the new formula with a quick substitution.

Year 10 Changing Subject Practice

1. Make x the subject of $y = \frac{3x-5}{2}$.

2. Make x the subject of $A = 3(2x - 5) + 4$.

3. Make q the subject of $p = \frac{q+r}{s}$.

4. Make b the subject of $S = \frac{(a+b)h}{2}$.

5. Make F the subject of $C = \frac{5}{9}(F - 32)$.

6. Make x the subject of $m = \frac{y-c}{x}$.

7. Make a the subject of $v^2 = u^2 + 2as$.

8. Make y_2 the subject of $m = \frac{y_2 - y_1}{x_2 - x_1}$.

Skill Practice

1. Evaluate $P = 2l + 2w$ when $l = 6$ and $w = 5$.

2. Evaluate $A = lw$ when $l = 8$ and $w = 7$.

3. Evaluate $C = 4n + 3$ when $n = 5$.

4. Evaluate $T = 3a - 2$ when $a = 9$.

5. Evaluate $V = Bh$ when $B = 12$ and $h = 4$.

6. Evaluate $d = rt$ when $r = 9$ and $t = 6$.

7. Evaluate $y = 2x + 7$ when $x = 8$.

8. Evaluate $m = 5p - 4$ when $p = 6$.

9. Evaluate $S = n^2 + 1$ when $n = 7$.

10. Evaluate $Q = 3x^2$ when $x = 4$.

11. Evaluate $E = 2a + b$ when $a = 5$ and $b = 7$.

12. Evaluate $P = 4s$ when $s = 9$.

13. Evaluate $M = 3u + 2v$ when $u = 4$ and $v = 5$.

14. Evaluate $F = ma$ when $m = 6$ and $a = 3$.

15. Evaluate $s = ut + 5$ when $u = 4$ and $t = 6$.

16. Evaluate $y = 4x - 5$ when $x = -2$.

17. Evaluate $A = 3p + q$ when $p = -4$ and $q = 10$.

18. Evaluate $T = 2n^2$ when $n = -3$.

19. Evaluate $R = 5a - 2b$ when $a = 3$ and $b = -4$.

20. Evaluate $z = \frac{x+6}{2}$ when $x = 10$.

21. Evaluate $k = \frac{3m-1}{5}$ when $m = 7$.

22. Evaluate $y = 2(x + 3)$ when $x = 5$.

23. Evaluate $c = 3(a - b)$ when $a = 9$ and $b = 2$.

24. Evaluate $N = a^2 - b$ when $a = 6$ and $b = 11$.

25. Evaluate $V = lwh$ when $l = 3$, $w = 4$, and $h = 5$.

26. Make x the subject of $y = x + 9$.

27. Make x the subject of $y = x - 6$.

28. Make x the subject of $A = 5x$.

29. Make q the subject of $p = 7q$.

30. Make n the subject of $m = \frac{n}{4}$.

31. Make x the subject of $y = \frac{x}{6}$.

32. Make r the subject of $C = 2r$.

33. Make h the subject of $V = Ah$.

34. Make s the subject of $d = st$.

35. Make m the subject of $F = ma$.

36. Make s the subject of $P = 4s$.

37. Make k the subject of $C = \frac{k}{3}$.

38. Make x the subject of $y = 3x + 5$.

39. Make x the subject of $y = 4x - 7$.

40. Make q the subject of $p = 2q + 9$.

41. Make b the subject of $A = 5b - 10$.

42. Make x the subject of $T = \frac{x+4}{3}$.

43. Make n the subject of $M = \frac{n-2}{5}$.

44. Make a the subject of $C = 2(a + b)$.

45. Make l the subject of $P = 2l + 2w$.

46. Make x the subject of $y = ax + b$.

47. Make t the subject of $v = u + at$.

48. Make u the subject of $s = ut + 5$.

49. Make d the subject of $F = 3c + 2d$.

50. Use $A = bh$ to find b when $A = -48$ and $h = 6$.

51. Use $P = 2l + 2w$ to find l when $P = -30$ and $w = -6$.

52. Use $v = u + at$ to find t when $v = -23$, $u = 5$, and $a = -4$.

53. Use $F = ma$ to find m when $F = -72$ and $a = 8$.

54. Use $y = 4x - 3$ to find x when $y = -27$.

55. Use $c = 2a + 5b$ to find a when $c = -31$ and $b = -3$.

56. Use $A = \frac{1}{2}bh$ to find h when $A = -45$ and $b = 10$.

57. Make r the subject of $C = 2\pi r$.

58. Use $V = lwh$ to find w when $V = -180$, $l = 9$, and $h = 5$.

59. Make x the subject of $y = 5x - 8$.

60. Make p the subject of $q = \frac{p-3}{4}$.

61. Use $S = 2a + 3b$ to find b when $S = -31$ and $a = -8$.

62. Make a the subject of $m = \frac{a+b}{2}$.

63. Use $P = 4s$ to find s when $P = -52$.

64. Use $y = 3x^2 - 5$ to find y when $x = -4$.

65. Use $y = x^2 - 2x$ to find y when $x = -3$.

66. Use $T = 2x^2 + 3x - 7$ to find T when $x = -5$.

67. Make x^2 the subject of $y = 5x^2 - 4$.

68. Make x the subject of $y = -3x + 8$.

69. Use $y = -2x + 5$ to find x when $y = 17$.

70. Use $y = 2x^2 - 5x + 1$ to find y when $x = -2$.

71. Use $R = 4x^2 + x - 6$ to find R when $x = -3$.

72. Make x the subject of $y = 7 - 2x$.

73. Make x the subject of $p = 5 - 4x$.

74. Use $y = 6 - 3x$ to find x when $y = 24$.

75. Use $T = x^2 + 4x$ to find T when $x = -6$.

76. Make x^2 the subject of $A = 2x^2 + 9$.

77. Use $C = -5x + 2$ to find x when $C = -28$.

78. Use $N = 3x^2 - 2x + 4$ to find N when $x = -1$.

Exam-Style Structured Practice

1. The area of a rectangle is given by $A = lw$. (a) Find A when $l = 12$ and $w = 5$. (b) Make l the subject. (c) Find l when $A = 96$ and $w = 8$. [5]
-

2. The perimeter of a rectangle is $P = 2l + 2w$. (a) Find P when $l = 9$ and $w = 4$. (b) Make l the subject. (c) Find l when $P = 44$ and $w = 7$. [6]
-

3. A number rule is $y = 3x + 4$. (a) Find y when $x = 6$. (b) Make x the subject. (c) Find x when $y = 31$. [5]
-

4. A motion formula is $v = u + at$. (a) Find v when $u = 4$, $a = 5$, and $t = 6$. (b) Make t the subject. (c) Find t when $v = 49$, $u = 9$, and $a = 8$. [6]
-

5. A formula is $C = 5n - 2$. (a) Find C when $n = 8$. (b) Make n the subject. (c) Find n when $C = 63$. [5]
-

6. A score is calculated by $S = 2p + 3q$. (a) Find S when $p = 4$ and $q = 5$. (b) Make q the subject. (c) Find q when $S = 41$ and $p = 7$. [6]
-

7. The volume of a cuboid is $V = lwh$. (a) Find V when $l = 8$, $w = 5$, and $h = 3$. (b) Make h the subject. (c) Find h when $V = 180$, $l = 9$, and $w = 5$. [6]
-

8. The mean of two numbers is $m = \frac{a+b}{2}$. (a) Find m when $a = 8$ and $b = 14$. (b) Make b the subject. (c) Find b when $m = 13$ and $a = 9$. [6]
-

9. A formula is $T = 4x - 3y$. (a) Find T when $x = 7$ and $y = 5$. (b) Make y the subject. (c) Find y when $T = 20$ and $x = 8$. [6]
-

10. A formula is $E = 3(n + 2)$. (a) Find E when $n = 5$. (b) Make n the subject. (c) Find n when $E = 45$. [5]

11. A formula is $q = \frac{p-5}{4}$. (a) Find q when $p = 29$. (b) Make p the subject. (c) Find p when $q = 11$. [5]

12. The area of a triangle is $A = \frac{bh}{2}$. (a) Find A when $b = 10$ and $h = 7$. (b) Make h the subject. (c) Find h when $A = 48$ and $b = 12$. [6]

13. A formula is $y = \frac{x+7}{5}$. (a) Find y when $x = 18$. (b) Make x the subject. (c) Find x when $y = 12$. [5]

14. A formula is $R = 2(a - b)$. (a) Find R when $a = 13$ and $b = 4$. (b) Make a the subject. (c) Find a when $R = 30$ and $b = 7$. [6]

15. A formula is $N = kx + c$. (a) Find N when $k = 4$, $x = 6$, and $c = 3$. (b) Make x the subject. (c) Find x when $N = 59$, $c = 11$, and $k = 6$. [6]

16. A distance formula is $D = rt$. (a) Find D when $r = 12$ and $t = 5$. (b) Make t the subject. (c) Find t when $D = 108$ and $r = 9$. [5]

17. A formula is $P = 4s + 6$. (a) Find P when $s = 5$. (b) Make s the subject. (c) Find s when $P = 54$. [5]

18. A formula is $H = 2x + 3y + 4$. (a) Find H when $x = 5$ and $y = 6$. (b) Make y the subject. (c) Find y when $H = 50$ and $x = 8$. [6]

19. Simple interest is given by $I = \frac{prt}{100}$. (a) Find I when $p = 200$, $r = 5$, and $t = 3$. (b) Make r the subject. (c) Find r when $I = 48$, $p = 300$, and $t = 4$. [6]

20. A formula is $y = mx + c$. (a) Find y when $m = 3$, $x = 7$, and $c = -2$. (b) Make m the subject. (c) Find m when $y = 38$, $c = 2$, and $x = 9$. [6]

21. A formula is $G = a(b + c)$. (a) Find G when $a = 4$, $b = 5$, and $c = 7$. (b) Make b the subject. (c) Find b when $G = 90$, $a = 6$, and $c = 8$. [6]

Mixed Review

1. Simplify $4x + 7x$.

2. Expand $3(x + 5)$.

3. Factorise $6x + 12$.

4. Solve $2x + 7 = 19$.

5. Solve $3x - 4 < 11$.

6. Evaluate $2a + 3$ when $a = 5$.

7. Write $8 \times r$ in algebraic notation.

8. Factorise $x^2 + 8x + 15$.

9. Expand $-2(x - 6)$.

10. Solve $\frac{x+4}{3} = 7$.

11. The n th term of a sequence is $3n + 2$. Find the 5th term.

Challenge Questions

1. The area formula $A = \frac{1}{2}h(a + b)$ is used for a trapezium. (a) Make h the subject. (b) Find h when $A = 84$, $a = 5$, and $b = 9$.

2. The formula $v^2 = u^2 + 2as$ links five variables. (a) Make s the subject. (b) Find s when $v = 13$, $u = 5$, and $a = 6$.

3. The circumference of a circle is $C = 2\pi r$. (a) Make r the subject. (b) Using $A = \pi r^2$, write A in terms of C .

4. A formula is $T = 3(2x - 5) + 4$. (a) Make x the subject. (b) Find x when $T = 37$.

5. A formula is $M = \frac{2a-3b}{5}$. (a) Make a the subject. (b) Find a when $M = 7$ and $b = 4$.

6. A rectangle has perimeter $P = 2l + 2w$. Its length is 5 more than its width, so $l = w + 5$. If $P = 50$, find w and l .

7. A linear formula is $y = kx + c$. It gives $y = 7$ when $x = 2$, and $y = 16$ when $x = 5$. Find k , c , and the formula.

8. An arithmetic sequence has formula $N = a + (n - 1)d$. (a) Make n the subject. (b) Find n when $N = 35$, $a = 5$, and $d = 3$.

9. Make x the subject of $A = 3(x - 2) + 5$.

10. Use $P = 2l + 2w$ to find w when $P = 56$ and $l = 18$.

11. Make h the subject of $V = \frac{1}{3}Ah$.

12. The formula $C = 5n + 12$. (a) Make n the subject. (b) Find n when $C = 87$.

13. Make x the subject of $M = 4(2x - 3) - 5$.

14. Use $A = \frac{1}{2}(a + b)h$ to find b when $A = 60$, $a = 8$, and $h = 6$.

15. Make b the subject of $y = mx + b$.

16. Make q the subject of $p = 3q - 2r$.

17. The formula $T = 5(2n - 1)$. (a) Make n the subject. (b) Find n when $T = 75$.

Chapter 8: Sequences

Chapter Goal

Generate terms, find n th-term rules, and connect tables to expressions.

Calculator Policy

This chapter is non-calculator. Check formulas by substituting $n = 1, 2, 3$ into the n th term.

Quick Notes - Page 1

A sequence is an ordered list. The term-to-term rule tells you how to move from one term to the next.

For 4, 7, 10, 13, ..., add 3 each time.

Quick Notes - Page 2

The n th term gives any term directly from its position.

For $3n + 1$:

$$n = 1 \Rightarrow 4, \quad n = 2 \Rightarrow 7, \quad n = 3 \Rightarrow 10$$

For an arithmetic sequence, the coefficient of n is the common difference.

Worked Examples

Example 1

Find the next two terms: 6, 11, 16, 21, ...

Solution: add 5, so the next two terms are 26, 31.

Example 2

Find the first four terms of $4n - 1$.

Solution: substitute $n = 1, 2, 3, 4$: 3, 7, 11, 15.

Example 3

Find the n th term of 5, 8, 11, 14, ...

Solution: common difference 3, and $3n + 2$ gives the first term, so the n th term is $3n + 2$.

Example 4

Which term of $2n + 5$ is 31?

Solution: $2n + 5 = 31$, so $2n = 26$, and $n = 13$.

Example 5

Is 55 in the sequence $4n + 3$?

Solution: $4n + 3 = 55$, so $n = 13$. Yes, it is the 13th term.

Example 6

A pattern has $5n + 2$ dots. Pattern 9 has $5(9) + 2 = 47$ dots.

Progress Tracker

Section	Questions	Completed	Correct	Retry
Skill Practice	52	[]	___ / 52	[]
Exam-Style Structured Practice	20	[]	___ / 20	[]
Mixed Review	11	[]	___ / 11	[]
Challenge Questions	7	[]	___ / 7	[]

Common Mistakes

- Treating the common difference as the full n th term.
- Forgetting that $n = 1$ gives the first term.
- Checking only one term of a proposed formula.
- Assuming every sequence is arithmetic.

Skill Practice

1. Find the next two terms: 3, 6, 9, 12, ...

2. Find the next two terms: 5, 9, 13, 17, ...

3. Find the next two terms: 20, 17, 14, 11, ...

4. Find the next two terms: 2, 6, 18, 54, ...

5. Find the next two terms: 96, 48, 24, 12, ...

6. Find the next two terms: 1, 4, 9, 16, ...

7. Find the next two terms: 2, 5, 10, 17, ...

8. Find the next two terms: 1, 3, 6, 10, ...

9. Find the next two terms: 7, 14, 28, 56, ...

10. Find the next two terms: 40, 35, 30, 25, ...

11. Find the next two terms: 4, 7, 12, 19, ...

12. Find the next two terms: 2, 3, 5, 8, 12, ...

13. Find the first five terms of the sequence with n th term $3n + 2$.

14. Find the first five terms of the sequence with n th term $5n - 1$.

15. Find the 8th term of the sequence with n th term $4n + 3$.

16. Find the 10th term of the sequence with n th term $7n - 2$.

17. Find the 12th term of the sequence with nth term $2n + 9$.

18. Find the 6th term of the sequence with nth term $n^2 + 1$.

19. Find the first five terms of the sequence with nth term n^2 .

20. Find the first four terms of the sequence with nth term 2^n .

21. Find the 7th term of the sequence with nth term $6n$.

22. Find the 4th term of the sequence with nth term $10 - n$.

23. Find the first five terms of the sequence with nth term $20 - 3n$.

24. Find the 15th term of the sequence with nth term $n + 8$.

25. Find the nth term of 4, 7, 10, 13, ...

26. Find the nth term of 5, 10, 15, 20, ...

27. Find the nth term of 9, 13, 17, 21, ...

28. Find the nth term of 2, 9, 16, 23, ...

29. Find the n th term of $-1, 2, 5, 8, \dots$

30. Find the n th term of $12, 10, 8, 6, \dots$

31. Find the n th term of $20, 17, 14, 11, \dots$

32. Find the n th term of $6, 11, 16, 21, \dots$

33. Find the n th term of $1, 6, 11, 16, \dots$

34. Find the n th term of $-4, 0, 4, 8, \dots$

35. Find the n th term of $100, 95, 90, 85, \dots$

36. Find the n th term of $8, 15, 22, 29, \dots$

37. Find the n th term of $3, 11, 19, 27, \dots$

38. Find the n th term of $2, 4, 6, 8, \dots$

39. Find the n th term of $10, 20, 30, 40, \dots$

40. Find the n th term of $0, 3, 6, 9, \dots$

41. Which term of the sequence $3n + 2$ is 29?

42. Which term of the sequence $5n - 1$ is 44?

43. Is 62 in the sequence with n th term $4n + 2$?

44. Is 50 in the sequence with n th term $6n + 1$?

45. Find n when the n th term $2n + 7$ is 31.

46. Which term of the sequence $100 - 5n$ is 60?

47. Which term of the sequence $7n - 3$ is 67?

48. Which term of the sequence $4 - 3n$ is -8 ?

49. Complete the values for $3n + 4$ when $n = 1, 2, 3, 4$.

50. Complete the values for $12 - 2n$ when $n = 1, 2, 3, 4$.

51. A pattern has $4n + 1$ matchsticks in pattern number n . How many matchsticks are in pattern 6?

52. A pattern has $3n + 2$ dots in pattern number n . Which pattern has 23 dots?

Exam-Style Structured Practice

1. The sequence 6, 10, 14, 18, ... is arithmetic. (a) State the term-to-term rule. (b) Find the next two terms. (c) Find the n th term. (d) Find the 20th term. [6]

2. The sequence 12, 19, 26, 33, ... is arithmetic. (a) Find the n th term. (b) Find the 15th term. (c) Which term is 96? [6]

3. The sequence 50, 45, 40, 35, ... is arithmetic. (a) Find the n th term. (b) Find the 8th term. (c) Which term is 0? [6]

4. A tile pattern has $3n + 1$ tiles in pattern number n . (a) Find the first five terms. (b) Find the 20th term. (c) Which pattern has 64 tiles? [6]

5. A matchstick pattern has 4, 7, 10, 13, ... sticks. (a) Find the n th term. (b) How many sticks are in pattern 12? (c) Which pattern has 49 sticks? [6]

6. The sequence $-2, 1, 4, 7, \dots$ is arithmetic. (a) Find the n th term. (b) Find the 30th term. (c) Which term is 43? [6]

7. A table gives $n = 1, 2, 3, 4$ and values 5, 8, 11, 14. (a) Find the n th term. (b) Find the value when $n = 25$. (c) Which position has value 62? [6]

8. An arithmetic sequence begins 7, $\square$, 19, 25, ... (a) Find the missing term. (b) Find the n th term. (c) Find the 10th term. [6]

9. A sequence has n th term $4n - 3$. (a) Find the first four terms. (b) Is 61 in the sequence? (c) Which term is 45? [6]

10. Mia saves \$12 in week 1 and increases the amount by \$5 each week. (a) Write the first four weekly amounts. (b) Find the n th term. (c) How much does she save in week 10? [6]

11. A sequence has n th term $3n + 4$. (a) Find the first three terms. (b) Find the 18th term. (c) Which term is 79? [6]

12. A sequence has n th term $n^2 + 2$. (a) Find the first five terms. (b) Find the 10th term. (c) Is 66 in the sequence? [6]

13. A dot pattern starts 8, 14, 20, 26, ... (a) Find the n th term. (b) Find the 12th term. (c) Which pattern has 74 dots? [6]

14. Two sequences are $A_n = 3n + 1$ and $B_n = 2n + 9$. (a) Find A_4 and B_4 . (b) Find the value of n when $A_n = B_n$. (c) Find the common value. [6]

15. Two sequences are $A_n = 5n - 2$ and $B_n = 3n + 10$. Find the first position n where $A_n > B_n$, and give both terms there. [6]

16. An arithmetic sequence has first term 11 and common difference -4 . (a) Find the n th term. (b) Find the 6th term. (c) Which term is -29 ? [6]

17. A function machine multiplies n by 4, then subtracts 1. (a) Find the formula. (b) Complete the values for $n = 1, 2, 3, 4$. (c) Which input gives output 47? [6]

18. A sequence has n th term $an + b$. The 4th term is 19, and the 9th term is 44. (a) Find a and b . (b) Find the 12th term. [6]

19. An arithmetic sequence has 3rd term 14 and 8th term 34. (a) Find the common difference. (b) Find the n th term. (c) Find the 20th term. [6]

20. A sequence has n th term $2n^2 - 1$. (a) Find the first four terms. (b) Find the 6th term. (c) Is 49 in the sequence? [6]

Mixed Review

1. Simplify $6x + 2x$.

2. Expand $5(x - 3)$.

3. Factorise $9x + 18$.

4. Solve $4x - 5 = 19$.

5. Solve $2x + 1 \leq 9$.

6. Make x the subject of $y = 2x + 5$.

7. Evaluate $x^2 + 3$ when $x = -2$.

8. Factorise $x^2 + 6x + 8$.

9. Find the n th term of 5, 8, 11, 14, ...

10. Solve $\frac{x-1}{4} = 3$.

11. Expand $-3(2x + 1)$.

Challenge Questions

1. A sequence begins 5, 11, 19, 29, 41, ... The second difference is constant. (a) Find the n th term. (b) Find the 10th term.
-

2. Pattern A has $4n + 1$ sticks. Pattern B has $3n + 8$ sticks. Find the pattern number when they have the same number of sticks, and find that number of sticks.
-

3. An arithmetic sequence has 4th term 17 and 11th term 52. Find the first term, the n th term, and the 100th term.
-

4. Two sequences have n th terms $4n + 1$ and $50 - 3n$. Find the value of n when the terms are equal, and find the equal term.
-

5. A counter pattern uses $\frac{n(n+1)}{2}$ counters in pattern n . (a) Find the 6th term. (b) Which pattern uses 45 counters?
-

6. An arithmetic sequence begins 7, 10, 13, ... and ends at 70. (a) How many terms are in the sequence? (b) Find the sum of all the terms.
-

7. A sequence has n th term $n^2 + 1$. (a) Find the 15th term. (b) Which term is 145?
-

Chapter 9: Straight-Line Graphs

Chapter Goal

Plot linear graphs and interpret gradient and intercept.

Calculator Policy

This chapter is non-calculator. Check graph answers by substituting points into the equation and by recalculating gradient.

Quick Notes - Page 1

A straight line can be written as $y = mx + c$.

The gradient is m . The y -intercept is c .

For $y = 2x + 3$, the gradient is 2 and the y -intercept is 3.

Quick Notes - Page 2

To find a gradient from two points, use

$$\text{gradient} = \frac{\text{change in } y}{\text{change in } x}.$$

For (1, 4) and (3, 10), the gradient is $\frac{10-4}{3-1} = 3$.

Worked Examples

Example 1

Complete a table for $y = x + 2$ when $x = 0, 1, 2$.

Solution: the y -values are 2, 3, 4.

Example 2

Find the gradient of the line through (0, 1) and (2, 5).

Solution: gradient = $\frac{5-1}{2-0} = 2$.

Example 3

Find the equation of a line with gradient 4 and y -intercept -1 .

Solution: $y = 4x - 1$.

Example 4

Find the x -intercept of $y = 2x - 8$.

Solution: set $y = 0$: $0 = 2x - 8$, so $x = 4$. The intercept is $(4, 0)$.

Example 5

Find the intersection of $y = x + 1$ and $y = 2x - 3$.

Solution: $x + 1 = 2x - 3$, so $x = 4$, and $y = 5$.

Example 6

Check whether $(3, 11)$ lies on $y = 3x + 2$.

Solution: $3(3) + 2 = 11$, so yes.

Progress Tracker

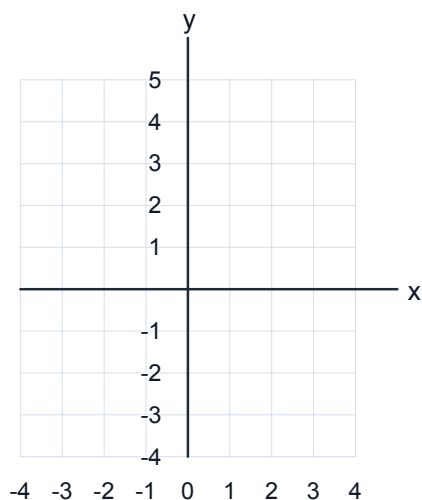
Section	Questions	Completed	Correct	Retry
Skill Practice	69	[]	___ / 69	[]
Exam-Style Structured Practice	23	[]	___ / 23	[]
Mixed Review	13	[]	___ / 13	[]
Challenge Questions	11	[]	___ / 11	[]

Common Mistakes

- Swapping the x -coordinate and y -coordinate when plotting.
- Reading the x -intercept as the y -intercept.
- Forgetting that parallel lines have equal gradients.
- Calculating gradient as change in x divided by change in y .

Skill Practice

1. On the coordinate plane below, plot the points $A(2, 3)$, $B(-1, 4)$, and $C(0, -2)$.



-
2. Which quadrant contains $(-3, 5)$?

-
3. Which point lies on the y -axis: $(4, 0)$, $(0, -4)$, or $(3, 3)$?

-
4. Which point lies on the x -axis: $(5, 0)$, $(0, 5)$, or $(-2, 2)$?

-
5. Complete the values for $y = x + 2$ when $x = 0, 1, 2, 3$.

-
6. Complete the values for $y = 2x + 1$ when $x = 0, 1, 2, 3$.

-
7. Complete the values for $y = 3x - 1$ when $x = 0, 1, 2, 3$.

-
8. Complete the values for $y = -x + 4$ when $x = 0, 1, 2, 3$.
-

9. Complete the values for $y = 5 - x$ when $x = 0, 1, 2, 3$.

10. Complete the values for $y = 2x - 3$ when $x = -1, 0, 1, 2$.

11. Complete the values for $y = -2x + 6$ when $x = 0, 1, 2, 3$.

12. Complete the values for $y = 4x$ when $x = -1, 0, 1, 2$.

13. Complete the values for $y = \frac{x}{2} + 1$ when $x = 0, 2, 4, 6$.

14. Complete the values for $y = 3 - x$ when $x = -1, 0, 1, 2$.

15. Complete the values for $y = 2x + 5$ when $x = -2, -1, 0, 1$.

16. Complete the values for $y = -3x + 1$ when $x = -1, 0, 1, 2$.

17. Find the gradient of the line through $(0, 1)$ and $(2, 5)$.

18. Find the gradient of the line through $(0, 3)$ and $(3, 9)$.

19. Find the gradient of the line through $(1, 2)$ and $(4, 11)$.

20. Find the gradient of the line through $(-1, 4)$ and $(2, 4)$.

21. Find the gradient of the line through $(0, 5)$ and $(5, 0)$.

22. Find the gradient of the line through $(-2, -1)$ and $(2, 7)$.

23. Find the gradient of the line through $(2, 8)$ and $(4, 2)$.

24. Find the gradient of the line through $(1, 5)$ and $(3, 6)$.

25. Find the gradient of the line through $(-4, 1)$ and $(0, 3)$.

26. Find the gradient of the line through $(-2, 6)$ and $(1, 0)$.

27. Find the gradient of the line through $(3, -1)$ and $(7, -1)$.

28. Find the gradient of the line through $(-3, -2)$ and $(0, 7)$.

29. State the gradient of $y = 2x + 3$.

30. State the y -intercept of $y = 2x + 3$.

31. State the gradient of $y = -x + 5$.

32. State the y -intercept of $y = 4x - 6$.

33. State the gradient and y -intercept of $y = -3x + 2$.

34. State the gradient and y -intercept of $y = \frac{1}{2}x - 4$.

35. Find the equation of a line with gradient 3 and y -intercept 2.

36. Find the equation of a line with gradient -2 and y -intercept 5.

37. Find the equation of a line with gradient $\frac{1}{2}$ and y -intercept -1 .

38. Find the equation of a line with gradient 2 through $(0, 4)$.

39. Find the equation of a line with gradient -1 through $(0, -3)$.

40. Find the equation of a line with gradient 5 through the origin.

41. Find the x -intercept and y -intercept of $2x + y = 8$.

42. Find the x -intercept and y -intercept of $3x - 2y = 12$.

43. A line is parallel to $y = -x + 5$ and passes through $(-2, 9)$. Write its equation and find its x -intercept.

44. A line is perpendicular to $y = 3x + 9$ and passes through $(6, -1)$. Write its equation and state its y -intercept.

45. Write three points to plot the line $y = x + 1$ using $x = 0, 1, 2$.

46. Write three points to plot the line $y = 2x$ using $x = -1, 0, 1$.

47. A line has gradient 2 and passes through $(3, 7)$. Write the equation of the line.

48. A line has gradient -1 and passes through $(4, 2)$. Write the equation of the line.

49. A line has gradient 3 and passes through $(-2, 5)$. Write the equation of the line.

50. A line has gradient $\frac{1}{2}$ and passes through $(6, -1)$. Write the equation of the line.

51. A line has gradient -3 and passes through $(-1, 8)$. Write the equation of the line.

52. State the gradient of the horizontal line $y = 4$.

53. Write the equation of the vertical line through $x = 3$.

54. Write the equation of the horizontal line through $y = -2$.

55. Which line is steeper: $y = 5x + 1$ or $y = 2x + 9$?

56. Does $(2, 7)$ lie on $y = 3x + 1$?

57. Does $(3, 4)$ lie on $y = 2x - 1$?

58. Find y on the line $y = 4x - 2$ when $x = 3$.

59. Find x on the line $y = 3x - 1$ when $y = 14$.

60. Find y on the line $y = -2x + 5$ when $x = -3$.

61. Find x on the line $y = 2x + 7$ when $y = 19$.

62. Does $(-1, 4)$ lie on $y = -3x + 1$?

63. State the gradient and y -intercept of $y = -5x + 8$.

64. Find the gradient of the line through $(2, 5)$ and $(6, 17)$.

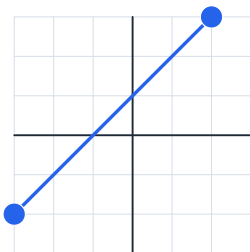
65. Write the equation of the line with gradient 4 and y -intercept -6 .

66. Find the intersection of $y = x + 3$ and $y = 3x - 1$.

67. Find the x -intercept of $y = 2x - 10$.

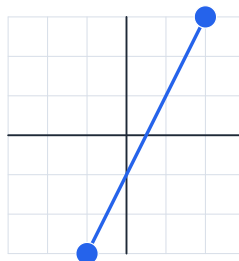
68. The eight coordinate systems below show lines A to H. Find the gradient of each line. Write "undefined" for any vertical line.

A



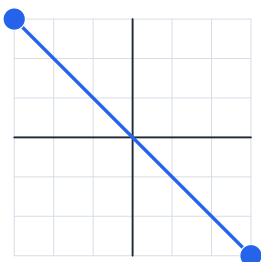
Gradient: _____

B



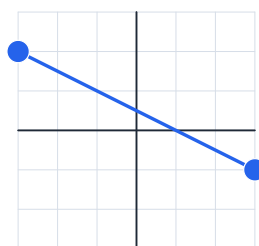
Gradient: _____

C



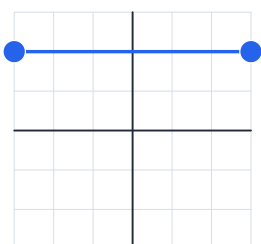
Gradient: _____

D



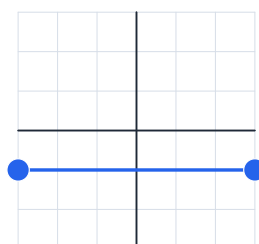
Gradient: _____

E



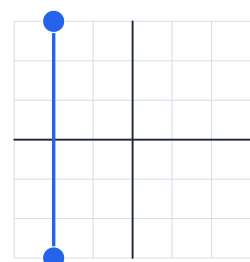
Gradient: _____

F



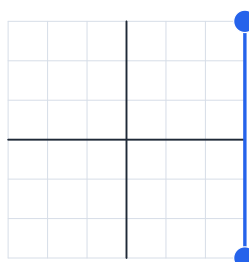
Gradient: _____

G



Gradient: _____

H



Gradient: _____

69. Find the intercepts or write the required line equation.

- Find the x -intercept and y -intercept of $y = 2x - 8$.
- Find the x -intercept and y -intercept of $y = -3x + 6$.
- Find the x -intercept and y -intercept of $y = \frac{1}{2}x + 3$.
- Find the x -intercept and y -intercept of $2x + 5y = 20$.
- Find the x -intercept and y -intercept of $3x - 4y = 12$.
- Write the equation of the line parallel to $y = 2x - 5$ that passes through $(3, 4)$.
- Write the equation of the line parallel to $y = -x + 7$ that passes through $(-2, 5)$.
- Write the equation of the line parallel to $y = \frac{1}{2}x + 1$ that passes through $(4, -1)$.
- Write the equation of the line perpendicular to $y = 2x + 3$ that passes through $(4, 1)$.
- Write the equation of the line perpendicular to $y = -3x + 2$ that passes through $(6, -1)$.
- Write the equation of the line perpendicular to $y = \frac{1}{2}x - 4$ that passes through $(-2, 6)$.
- Write the equation of the line perpendicular to $y = -\frac{1}{4}x + 5$ that passes through $(8, -3)$.

[illegible]

Exam-Style Structured Practice

1. For the line $y = 2x + 3$: (a) complete a table for $x = 0, 1, 2, 3$; (b) state the gradient; (c) state the y -intercept. [6]

2. For the line $y = -x + 4$: (a) complete a table for $x = 0, 1, 2, 3, 4$; (b) state the y -intercept; (c) find the x -intercept. [6]

3. A line passes through $(0, 2)$ and $(3, 8)$. (a) Find the gradient. (b) Find the equation. (c) Does $(5, 12)$ lie on the line? [6]

4. A line has gradient -2 and passes through $(0, 6)$. (a) Write its equation. (b) Find its x -intercept. (c) Find y when $x = -1$. [6]

5. A line passes through $(1, 4)$ and $(3, 10)$. (a) Find the gradient. (b) Find the equation. (c) Find y when $x = 6$. [6]

6. A line passes through $(-2, 7)$ and $(2, -1)$. (a) Find the gradient. (b) Find the equation. (c) Find the x -intercept. [6]

7. For $y = 3x - 4$: (a) state the gradient; (b) find the y -intercept; (c) find y when $x = 5$. [5]

8. A line is parallel to $y = 4x - 1$ and passes through $(0, 6)$. (a) Find its equation. (b) Does $(2, 14)$ lie on it? [5]

9. Find the point of intersection of $y = 2x + 1$ and $y = x + 5$. [5]

10. Find the point of intersection of $y = -x + 7$ and $y = 2x + 1$. [5]

11. A taxi cost is $C = 3d + 5$, where d is distance in km. (a) Find the fixed cost. (b) Find the cost per km. (c) Find the cost for 8 km. [6]

12. A club cost is $C = 12n + 20$. (a) State the gradient. (b) State the intercept and what it means. (c) Find C when $n = 6$. [6]

13. A straight line passes through $(1, 2)$ and $(5, 10)$. (a) Find the gradient. (b) Find the equation. (c) Find y when $x = 9$. [6]

14. A table has $x = 0, 1, 2, 3$ and $y = -2, 1, 4, 7$. Find the equation of the line. [5]

15. A table has $x = 0, 2, 4$ and $y = 5, 9, 13$. Find the equation of the line. [5]

16. Find the point of intersection of the lines $y = 3$ and $x = -2$. [3]

17. A line passes through $(0, -4)$ and is parallel to $y = -3x + 2$. (a) Find the equation. (b) Find y when $x = -2$. [5]

18. Find the x -intercepts of $y = x - 6$ and $y = 2x - 6$. Which line reaches the x -axis first as x increases from 0? [6]

19. A line $y = mx + c$ passes through $(0, 5)$ and $(4, 13)$. (a) Find m and c . (b) Find x when $y = 31$. [6]

20. For $y = \frac{1}{2}x + 2$: (a) complete the values for $x = 0, 2, 4, 6$; (b) state the gradient; (c) find x when $y = 5$. [6]

21. A proportional graph has equation $y = kx$. It passes through $(7, 28)$. (a) Find k . (b) Find y when $x = 11$.
(c) Find x when $y = 60$. [6]

22. A student says that $y = 2x + 3$ has y -intercept 2. Explain the error and give the correct gradient and y -intercept. [5]

23. For $y = 5x - 10$: (a) state the gradient; (b) find the y -intercept; (c) find the x -intercept; (d) decide whether $(4, 10)$ lies on the line. [6]

Mixed Review

1. Simplify $7x + 5x$.

2. Expand $4(x - 2)$.

3. Factorise $10x + 15$.

4. Solve $3x + 2 = 20$.

5. Solve $4x - 3 > 9$.

6. Make x the subject of $y = 5x - 4$.

7. Find the n th term of 2, 6, 10, 14, ...

8. State the gradient of $y = -4x + 1$.

9. Does $(1, 6)$ lie on $y = 4x + 2$?

10. Evaluate $2a^2 - 3$ when $a = 4$.

11. Factorise $x^2 + 9x + 20$.

12. Which term of $3n + 1$ is 40?

13. Find the y -intercept of $y = 6 - 2x$.

Challenge Questions

1. Line A is $y = 2x + 3$. Line B is $y = -x + 12$. (a) Find their intersection. (b) Does the line $y = x + 6$ pass through the same point?

2. A line passes through $(2, 3)$ and $(6, 5)$. (a) Find its equation. (b) Find x when $y = 9$.

3. Find k if the point $(4, k)$ lies on $y = -3x + 10$.

4. The line $y = kx + 2$ passes through $(3, 14)$. (a) Find k . (b) Find the x -intercept.

5. Find a if the line through $(0, a)$ and $(4, 13)$ has gradient 3. Then write the equation of the line.

6. Plan A costs $C = 2d + 10$. Plan B costs $C = 5d + 1$. Find the value of d when the costs are equal, the equal cost, and which plan is cheaper for $d = 1$.

7. A straight line passes through $(-1, 0)$ and $(2, 9)$. Find its equation and its y -intercept.

8. Lines $L_1 : y = x + 4$ and $L_2 : y = 3x - 2$ meet at P . Find P , then decide whether $L_3 : y = 2x + 1$ also passes through P .

9. A line passes through $(0, -3)$ and $(4, 9)$. Find its equation and its x -intercept.

10. Lines $y = 2x + a$ and $y = -x + 9$ meet where $x = 3$. Find a and the intersection point.

11. Plan A costs $C = 12 + 4d$. Plan B costs $C = 6 + 6d$. Find the distance when the costs are equal, the equal cost, and which plan is cheaper when $d = 5$.

Chapter 10: Algebra Mixed Review

Chapter Goal

Combine notation, simplification, equations, formulae, sequences, and graphs.

Calculator Policy

This chapter is non-calculator. Check answers by substituting into the original expression, equation, formula, sequence, or line.

Quick Notes - Page 1

First identify the topic. A mixed review is designed to make you switch methods.

- Simplify: collect like terms.
- Expand: multiply into brackets.
- Factorise: put brackets back in.
- Solve: isolate the unknown.

Quick Notes - Page 2

For formulae, sequences, and graphs, substitution is the safest check.

$$y = 3x + 2, x = 4 \Rightarrow y = 14$$

For a line $y = mx + c$, m is the gradient and c is the y -intercept.

Worked Examples

Example 1

Simplify $4x + 7x - 3x$.

Solution: $8x$.

Example 2

Expand and simplify $3(x + 2) - x$.

Solution: $3x + 6 - x = 2x + 6$.

Example 3

Solve $5x - 4 = 21$.

Solution: $5x = 25$, so $x = 5$.

Example 4

Make x the subject of $y = 2x + 7$.

Solution: $x = \frac{y-7}{2}$.

Example 5

Find the n th term of 6, 10, 14, ...

Solution: $4n + 2$.

Example 6

Find the gradient of $y = -3x + 5$.

Solution: -3 .

Progress Tracker

Section	Questions	Completed	Correct	Retry
Skill Practice	86	[]	___ / 86	[]
Exam-Style Structured Practice	26	[]	___ / 26	[]
Mixed Review	14	[]	___ / 14	[]
Challenge Questions	13	[]	___ / 13	[]

Common Mistakes

- Solving when the question asks to simplify.
- Expanding brackets when factorising is required.
- Forgetting to reverse the inequality sign after dividing by a negative.
- Using the common difference as the whole n th term.
- Reading a graph's intercept as its gradient.

Skill Practice

1. Write $3 \times a \times b$ in algebraic notation.

2. Write $x \times x \times y$ in algebraic notation.

3. Evaluate $2x + 5$ when $x = 7$.

4. Evaluate $4a - 3b$ when $a = 5$ and $b = 2$.

5. Evaluate $x^2 - 2x$ when $x = -3$.

6. Evaluate $3p^2 + 1$ when $p = 4$.

7. Evaluate $A = lw$ when $l = 9$ and $w = 5$.

8. Evaluate $P = 2l + 2w$ when $l = 8$ and $w = 3$.

9. Simplify $3x + 8x$.

10. Simplify $10a - 4a$.

11. Simplify $5p + 2q + 3p - q$.

12. Simplify $7x - 2y - 3x + 5y$.

13. Simplify $4m - 9 + 2m + 5$.

14. Simplify $6a + 3b - 2a - 8b$.

15. Simplify $12x - 5 + 3x + 11$.

16. Simplify $2r + 4s + 7r - 9s$.

17. Simplify $a + a + a + 5a$.

18. Simplify $9x - 4x + x$.

19. Expand $3(x + 4)$.

20. Expand $5(a - 2)$.

21. Expand $-2(x + 6)$.

22. Expand $-3(y - 5)$.

23. Expand $4(2x + 1)$.

24. Expand $2(3a - 7)$.

25. Expand $x(x + 5)$.

26. Expand $3x(x - 4)$.

27. Expand and simplify $2(x + 3) + x$.

28. Expand and simplify $4(x - 1) - 2x$.

29. Factorise $6x + 12$.

30. Factorise $10a - 15$.

31. Factorise $x^2 + 5x + 6$.

32. Factorise $x^2 + 9x + 20$.

33. Factorise $x^2 - x - 12$.

34. Factorise $x^2 - 16$.

35. Factorise $3x^2 + 6x$.

36. Factorise $4y^2 - 12y$.

37. Factorise $2x^2 + 7x + 3$.

38. Factorise $3x^2 - 12$.

39. Solve $x + 7 = 15$.

40. Solve $x - 9 = -2$.

41. Solve $4x = 28$.

42. Solve $\frac{x}{5} = 6$.

43. Solve $3x + 4 = 22$.

44. Solve $5x - 7 = 18$.

45. Solve $2(x + 3) = 18$.

46. Solve $3(x - 2) = 21$.

47. Solve $4x + 5 = 2x + 17$.

48. Solve $\frac{x+4}{3} = 8$.

49. Solve $2(x - 5) + 3 = 17$.

50. Solve $5(x + 1) = 3x + 19$.

51. Solve $x + 5 < 12$.

52. Solve $x - 4 \geq 9$.

53. Solve $2x + 3 \leq 17$.

54. Solve $5x - 2 > 18$.

55. Solve $-3x < 12$.

56. Solve $4(x - 1) \geq 20$.

57. Solve $2x + 5 < x + 11$.

58. Solve $-2x + 7 \leq 15$.

59. Evaluate $y = 3x + 2$ when $x = 5$.

60. Evaluate $A = lw$ when $l = 7$ and $w = 6$.

61. Make x the subject of $y = 4x - 1$.

62. Make h the subject of $V = Ah$.

63. Use $P = 2l + 2w$ to find l when $P = 34$ and $w = 5$.

64. Use $v = u + at$ to find a when $v = 26$, $u = 6$, and $t = 5$.

65. Find the n th term of 4, 9, 14, 19, ...

66. Find the 12th term of the sequence $3n + 2$.

67. State the gradient of $y = -2x + 5$.

68. State the y -intercept of $y = 4x - 7$.

69. Find the gradient of the line through $(0, 1)$ and $(3, 7)$.

70. Find the intersection of $y = x + 2$ and $y = 2x - 1$.

71. Simplify $5x - 3y + 2x + 7y - 4$.

72. Expand and simplify $4(2x - 3) - 3(x + 5)$.

73. Factorise $3x^2 + 12x$ fully.

74. Solve $5x - 7 = 2x + 14$.

75. Solve $-2x + 3 \geq 11$.

76. Make r the subject of $A = \pi r^2$.

77. Find the n th term of 11, 8, 5, 2, ...

78. Find the intersection of $y = -x + 8$ and $y = 2x - 1$.

79. Simplify $8a - 5b - 3a + 2b + 9$.

80. Expand and simplify $-2(3x - 4) + 5x$.

81. Factorise $x^2 + 11x + 30$.

82. Solve $3(x + 2) = 2x + 15$.

83. Solve $4x - 5 < 2x + 11$.

84. Make m the subject of $F = ma$.

85. Find the 15th term of the sequence $6n - 4$.

86. Find the intersection of $y = 3x - 2$ and $y = x + 6$.

Exam-Style Structured Practice

1. (a) Simplify $3a + 5a - 2a$. (b) Evaluate $2x^2 - 3$ when $x = -4$. (c) Write $4 \times m \times n$ in algebraic notation. [6]
-

2. (a) Expand and simplify $5(x - 3) - 2x$. (b) Factorise $6y + 18$. (c) Solve $3x - 15 = 0$. [6]
-

3. Solve $4(x + 2) = 3x + 17$, then check your answer in the original equation. [5]
-

4. Solve $-2x + 5 < 13$, then describe the answer on a number line. [5]
-

5. The area of a rectangle is $A = lw$. (a) Find A when $l = 12$ and $w = 6$. (b) Make w the subject. (c) Find w when $A = 90$ and $l = 15$. [6]
-

6. The sequence 7, 11, 15, 19, ... is arithmetic. (a) Find the n th term. (b) Find the 20th term. (c) Which term is 99? [6]
-

7. For $y = 2x - 3$: (a) complete a table for $x = 0, 1, 2$; (b) state the gradient; (c) find the x -intercept. [6]
-

8. Factorise $x^2 + 7x + 12$. Hence find the values of x for which $x^2 + 7x + 12 = 0$. [5]
-

9. Find the intersection of $y = 3x + 1$ and $y = x + 9$. [5]
-

10. (a) Solve $\frac{x+5}{2} = 9$. (b) Use your answer as x in $y = 2x + 1$. [5]
-

11. Two sequences have n th terms $A_n = 2n + 5$ and $B_n = 4n - 3$. (a) Find n when $A_n = B_n$. (b) Find the common value. (c) For which whole-number positions is $A_n < B_n$? [7]
-
12. A line passes through $(0, 4)$ and $(2, 10)$. (a) Find the gradient. (b) Find the equation. (c) Find y when $x = 5$. [6]
-
13. (a) Expand and simplify $-3(x - 4) + 2x$. (b) Solve $-x + 12 = 5$. [5]
-
14. (a) Factorise $8x - 20$. (b) Factorise $x^2 - 25$. [5]
-
15. (a) Solve $7x - 5 = 3x + 19$. (b) Solve $7x - 5 > 3x + 19$. [6]
-
16. Make b the subject of $C = 2a + 3b$, then find b when $C = 31$ and $a = 5$. [6]
-
17. A sequence has n th term $5n - 2$. (a) Find the first four terms. (b) Which term is 68? [5]
-
18. For the line $y = 2x + 2$: (a) does $(3, 8)$ lie on the line? (b) does $(4, 7)$ lie on the line? (c) state the gradient. [5]
-
19. A taxi fare is $C = 4d + 6$. (a) Find the cost for $d = 7$. (b) Find d when $C = 50$. [5]
-
20. (a) Factorise $2x^2 + 10x$. (b) Solve $2x(x + 5) = 0$. [5]
-
21. Tickets cost 8 each plus a fixed booking fee of 6. The total is no more than 54. (a) Write an inequality for t tickets. (b) Find the greatest possible value of t . [6]
-

22. For $y = -3x + 9$, find the gradient, the y -intercept, and the x -intercept. [6]

23. A pattern has $4n + 1$ tiles. (a) Find the first four terms. (b) Which pattern has 45 tiles? [5]

24. Make x the subject of $y = \frac{x-3}{4}$, then find x when $y = 6$. [5]

25. Solve $2a + 3 = 15$, then evaluate $5a - 4$. [5]

26. A line passes through $(1, 2)$ and $(4, 11)$. (a) Find the gradient. (b) Find the equation. (c) Find x when $y = 20$. [6]

Mixed Review

1. Write $6 \times p \times q$ in algebraic notation.

2. Simplify $4x - 7x + 2x$.

3. Expand $2(3x - 5)$.

4. Factorise $12x + 8$.

5. Solve $\frac{x}{3} + 4 = 9$.

6. Solve $-4x > 20$.

7. Make t the subject of $d = rt$.

8. Find the n th term of 6, 13, 20, 27, ...

9. Find the 9th term of $2n - 3$.

10. Find the gradient through (2, 3) and (5, 12).

11. Find the y -intercept of $y = -x + 8$.

12. Find the x -intercept of $y = x + 6$.

13. Factorise $x^2 + 3x - 10$.

14. Evaluate $3x^2 - 2x$ when $x = -2$.

Challenge Questions

1. Find the intersection of $y = 2x + 5$ and $y = 5x - 4$.

2. The line $y = kx + 3$ passes through (4, 19). Find k , then find the x -intercept.

3. A rectangle has length $x + 3$ and width $2x - 1$. Its perimeter is 40. Find x , then find the area.

4. An arithmetic sequence has 5th term 22 and 12th term 50. Find the first term, the n th term, and the 100th term.

5. Factorise $x^2 + 2x - 35$, then solve $x^2 + 2x - 35 = 0$.

6. Solve $3x + 2 \leq 2x + 9$. List the positive integer solutions.

7. Plan A costs $12 + 3n$. Plan B costs $5n$. Find the value of n when the plans cost the same, the equal cost, and the cheaper plan when $n = 4$.

8. A line through $(0, c)$ and $(5, 18)$ has gradient 3. Find c , the equation of the line, and the x -intercept.

9. If $a = 2b + 1$, write $3a - b$ in terms of b . Then find its value when $b = 4$.

10. A sequence has n th term $n^2 + 2n$. Find the 8th term, then find which term is 48.

11. A line through $(2, k)$ and $(6, 17)$ has gradient 3. Find k and the equation of the line.

12. Factorise $x^2 - x - 20$, then solve $x^2 - x - 20 = 0$.

13. A sequence has n th term $an + b$. Its 4th term is 17 and its 10th term is 41. Find a , b , and the 25th term.

Chapter 1 Answer Key - Algebraic Notation and Substitution

Skill Practice

1. $3a$
2. $7b$
3. x
4. m^2
5. $2pq$
6. $5r^2$
7. $4st$
8. $\frac{y}{3}$
9. $8xy$
10. abc
11. $6n^3$
12. $\frac{d}{5}$
13. $9h + 2h$
14. $10k - 3k$
15. uv^2
16. $\frac{12x}{5}$
17. 13
18. 11
19. 17
20. 11
21. 52
22. 50
23. 26
24. 17
25. 23
26. 26
27. 34
28. 1
29. 13
30. 6
31. 35
32. 73
33. 27
34. 6
35. 70
36. 51
37. 100
38. -6
39. 3
40. 9
41. 26
42. -20
43. -5
44. -1
45. -19
46. 16
47. 3
48. -8
49. -8
50. 16
51. 7
52. 45
53. -18
54. -3
55. -4
56. -21
57. $P = 26$
58. $A = 84$
59. $C = 36$
60. $V = 120$
61. $F = 35$
62. $T = 26$
63. $A = 45$
64. $P = 34$
65. $S = 72$
66. $M = 29$
67. $D = 195$
68. $Q = 8$
69. $E = 44$
70. $N = 65$
71. $n + 5$
72. $3x$
73. $p - 7$
74. $4y$
75. $\frac{m}{2}$
76. t^2
77. $3a + 2$
78. $2b - 6$
79. $x + y$

80. $q - 9$

Mixed Review

1. $4x^2$; 36
2. 39
3. 38
4. 21
5. $5n - 3$; 37
6. 11
7. 56
8. 7
9. $6d + 4$; 58
10. 23
11. 210
12. ab^2c ; 90
13. -15
14. $2r + 11$; -1
15. 72; fixed cost
16. $(3x)^2$ is larger; values are 75 and 225
17. $\frac{11}{3}$
18. $2p + 5$; 33
19. -21
20. -33

Challenge Questions

1. 37
2. $6w + 14$; 50
3. 112
4. B is greater; $A = 3$, $B = 21$
5. 6
6. -5 and 5
7. 30
8. For example, 5k
9. -11
10. 2, 10, 24; increases are 8 then 14
11. -10
12. $p = 7$
13. Both give 0
14. $p = 3$
15. $q = -15$
16. 5 and -4
17. $a = 7$
18. $t = -7$ or $t = 7$

Quadratic Equation Practice

1. $x = -3$ or $x = -4$
2. $x = 2$ or $x = 3$
3. $x = 4$ or $x = -5$
4. $x = 3$ or $x = -3$
5. $x = -3$ or $x = -\frac{1}{2}$
6. $x = 3$ or $x = \frac{2}{3}$
7. $x = 5$ or $x = -3$
8. $x = 3$ or $x = -7$
9. $x = \frac{5}{2}$ or $x = -\frac{5}{2}$
10. $x = 3$ or $x = -\frac{5}{2}$
11. $x = \frac{1}{2}$ or $x = -\frac{3}{2}$
12. $x = 2$ or $x = -2$
13. $x = 4$
14. $x = -\frac{2}{3}$
15. $x = -3$ or $x = -7$
16. $x = 5$ or $x = 8$
17. $x = \frac{3}{2}$ or $x = -4$
18. $x = \frac{3}{2}$ or $x = -\frac{5}{2}$
19. $x = -2$ or $x = -\frac{4}{3}$
20. $x = \frac{4}{3}$ or $x = \frac{3}{2}$
21. $x = 2$ or $x = -7$
22. $x = 0$ or $x = 6$
23. $x = -\frac{1}{2}$ or $x = 5$
24. $x = 0$ or $x = -4$
25. $x = -1 \pm \sqrt{2}$
26. $x = 2 \pm \sqrt{3}$
27. $x = -1$ or $x = -5$
28. $x = \frac{1}{2}$ or $x = -2$
29. $x = 1$ or $x = -\frac{1}{3}$
30. $x = \frac{-1 \pm \sqrt{5}}{2}$
31. $x = 1 \pm \frac{\sqrt{10}}{2}$
32. $x = \frac{1}{3}$ or $x = -2$
33. $x = 1$ or $x = \frac{1}{5}$
34. $x = \frac{-1 \pm \sqrt{15}}{2}$
35. $x = \frac{3}{2}$ or $x = -\frac{1}{2}$
36. $x = \frac{3 \pm \sqrt{17}}{2}$
37. $x = -1$ or $x = -\frac{1}{3}$
38. $x = \frac{5 \pm \sqrt{17}}{4}$

39. $x = -4 \pm \sqrt{6}$

40. $x = \frac{-1 \pm \sqrt{6}}{5}$
41. $x = -\frac{1}{2}$ or $x = -\frac{5}{2}$
42. $x = 1 \pm \sqrt{6}$
43. $x = -1$ or $x = -5$
44. $x = 3$ or $x = 7$
45. $x = -2 \pm \sqrt{5}$
46. $x = 1$ or $x = 7$
47. $x = 2$ or $x = -4$
48. $x = 3 \pm \sqrt{13}$
49. $x = -2$ or $x = -10$
50. $x = 2 \pm \sqrt{11}$
51. $x = -2 \pm \frac{\sqrt{10}}{2}$
52. $x = 2 \pm \sqrt{2}$
53. $x = -\frac{1}{2}$ or $x = -\frac{7}{2}$
54. $x = 3 \pm \frac{\sqrt{26}}{2}$
55. $x = -5$ or $x = -9$
56. $x = 3$ or $x = -1$
57. $x = \frac{-5 \pm \sqrt{17}}{2}$
58. $x = 1$ or $x = 6$
59. $x = -1 \pm \frac{\sqrt{22}}{2}$
60. $x = 1 \pm \frac{2\sqrt{10}}{5}$

Equation Application Practice

1. $3n + 7 = 34$; $n = 9$
2. $4n + 6 = 30$; $n = 6$ dollars
3. $2x + 8 = 50$; $x = 21$ cm
4. $k + (k + 5) = 43$; Kai = 19, Omar = 24
5. $n + (n + 1) + (n + 2) = 72$; 23, 24, 25
6. $2w + 2(w + 5) = 46$; $w = 9$ cm, $l = 14$ cm
7. $4 + 2.5d = 24$; $d = 8$ km
8. $n + (2n + 4) = 34$; Nina = 10, Diego = 24
9. $b + (b + 6) = 30$; boys = 12, girls = 18
10. $5n - 13 = 42$; $n = 11$
11. $r + 3r = 44$; red = 11, blue = 33
12. $7p + 2 = 9.70$; $p = 1.10$ dollars
13. $j + (\frac{1}{2} + 2) = 17$; Jae = 10 km, Sarah = 7 km
14. $2(n - 9) = 26$; $n = 22$
15. $m - \frac{3}{5}m = 18$; $m = 45$ dollars
16. $6l = 78$; $l = 13$ cm
17. $12 + 0.20t = 23.20$; $t = 56$
18. $x + 3x + 20 = 180$; 40° , 140°
19. $\frac{2x-4}{5} = 9$; $n = 49$
20. $3x + 12 = 87$; $x = 25$
21. $s + (2s - 8) = 58$; 22, 36
22. $2w + 2(3w - 2) = 68$; $w = 9$ cm, $l = 25$ cm
23. $(x + 5) + (2x + 3) + (2x + 7) = 65$; 15 cm, 23 cm, 27 cm
24. $a + 5a = 72$; adults = 12, children = 60
25. $3(s + 4) + 2s = 52$; small = 8 dollars, large = 12 dollars
26. $4(x - 3) = 2x + 18$; $x = 15$
27. $13 + 5w = 48$; $w = 7$
28. $120 - 8t = 56$; $t = 8$ minutes
29. $-6 + 3h = 15$; $h = 7$ hours
30. $3 - 2s = -9$; $s = 6$
31. $18 + 7h = 67$; $h = 7$
32. $\frac{n}{4} - 6 = -2$; $n = 16$
33. $x + (x + 6) + 2x = 54$; 12, 18, 24
34. $\frac{x+(x+4)+(x+8)}{3} = 18$; 14, 18, 22
35. $7k = 490$; flour = 350 g, sugar = 140 g
36. $x + (2x - 18) = 147$; 55 km, 92 km
37. $x(x + 2) = 48$; 6 cm by 8 cm
38. $n(n + 1) = 132$; 11, 12
39. $\frac{x(x+7)}{2} = 60$; 8 cm and 15 cm
40. $x(2x + 1) = 78$; 6 cm by 13 cm
41. $x^2 = 81$; $x = 9$ cm
42. $x(x + 5) = 104$; 8 cm by 13 cm
43. $x(x - 4) = 45$; $x = 9$
44. $x(x + 6) = 135$; 9 m by 15 m
45. $n(n + 2) = 143$; 11, 13
46. $-t^2 + 8t + 9 = 24$; $t = 3$ s or 5 s
47. $x(17 - x) = 60$; 5 cm by 12 cm

48. $x(x + 6) = 72$; 6, 12

Fractional Algebra and Fractional Equation Practice

1. $\frac{2x}{3}$
2. $\frac{3a}{4}$
3. $\frac{3x}{4}$
4. $\frac{3b}{4}$
5. $x + 5$
6. $a - 2$
7. $x + 2$
8. $3q$
9. $x + 2$
10. $2p - 3$
11. $\frac{2u}{3}$
12. $2m + 3$
13. $x + 3$
14. $x + 2$
15. $x + 4$
16. $x - 5$
17. $x - 2$
18. $x + 3$
19. $x + 3$
20. $x - 4$
21. $x + 3$
22. $x + 3$
23. $2x + 3$
24. $3x - 4$
25. $x + 2$
26. $2x - 3$
27. $4a - 1$
28. $\frac{2m}{3}$
29. $x - 4$
30. $x + 3$
31. $x + 2$
32. $x - 1$
33. $\frac{x}{2}$
34. $\frac{3a-1}{8}$
35. $\frac{x-1}{2}$
36. $\frac{13x}{15}$
37. $\frac{10m}{12}$
38. $\frac{a+1}{2}$
39. $\frac{3}{2}$
40. 1
41. $2x$
42. $\frac{2}{3}$
43. 3
44. $\frac{13x}{24}$
45. $x = 8$
46. $x = 4$
47. $x = 11$
48. $x = 26$
49. $\frac{120}{v} = 3$; $v = 40$ km/h
50. $\frac{4s}{x+5} = 1.5$; $s = 30$ km/h
51. $\frac{84}{x+5} = 3$; $x = 23$, speed = 28 km/h
52. $\frac{18}{r-2} = 3$; $r = 8$, speed = 6 km/h
53. $\frac{96}{x} = \frac{96}{x+8} + 1$; $x = 24$
54. $\frac{120}{x} = \frac{120}{x+10} + 1$; $x = 30$
55. $\frac{150}{x} = \frac{150}{x+25} + 1$; $x = 50$
56. $\frac{72}{x} = \frac{72}{x+6} + 1$; $x = 18$

Chapter 2 Answer Key - Collecting Like Terms

Skill Practice

1. $5x$
2. $11a$
3. $7m$
4. $6p$
5. $7y$
6. $2x$
7. $-4n$
8. $-7a$
9. $7b$
10. 0
11. $5x + 9$
12. $10a + 4$
13. $3m + 5$
14. $4p + 5$
15. $-2y + 8$
16. 9
17. $8b - 7$
18. $-7q + 9$
19. -3

20. $10a - 10$
21. $6x + 2y$
22. $8a + 5b$
23. $5m + 4n$
24. $3p - 3q$
25. $7x - 3y$
26. $4a - 5b$
27. $9n$
28. $-5p + 8q$
29. $-5x$
30. $8a - 5b$
31. $8x^2 + x$
32. $5a^2 + 3a$
33. $5p^2 - 4p$
34. $4x^2 + 5x$
35. $3xy + 7x$
36. 3
37. $5a^2 - 3a$
38. $-7p^2 - 3p$
39. $8x + y$
40. $3a - 4b$
41. $4m - 4$
42. $3p + 6q$
43. $4x + 4y$
44. $7a - 6$
45. $-10n - 2k$
46. $6x - 2$
47. $4x + 5$
48. $2x - 4$
49. $8a + b + 3$
50. $7x + 7y$
51. $7n - 1$
52. $2x + 8$
53. $2m + 6n$
54. $6p + 5$
55. $7x^2 - 4x$
56. $6x + 3y + 5$
57. $6a^2 + 5a - 6$
58. $4p + 4q - 4$
59. $8m^2 - 5m - 7$
60. $2x + 2y + 5$
61. $4a + 5b - 7$
62. $-3r^2 - r + 11$
63. $7x + 2y + 2z$

Exam-Style Structured Practice

1. $5x + 4$, 24
2. $4x + 6$
3. $8x + 14$
4. $7a + 2b + 3$
5. $6m + 8$
6. $7x^2 - x + 6$
7. $k = 8$
8. $2x + 3y$
9. $6a + 2b + 3$
10. $2x - 4$
11. $4a - 5b - 2$
12. $7x + 7y$
13. $6x + 4$
14. $7x + 3$, 17
15. Yes, both simplify to $4x + y$
16. $5x - 3y$
17. $7n - 1$
18. $7x^2 - 4x - 3$
19. p -terms and q -terms; $2p + 8q - 6$
20. $7x$
21. $a = 7$, $b = 8$

Mixed Review

1. $4a$
2. 17
3. $7x$
4. -11
5. $3b^2$
6. $2m + 3n$
7. 15
8. $8p - 10$
9. 16
10. $2a + 6b$
11. $n + 6$

Challenge Questions

1. $a = 6$, $b = -4$

2. $6x + 6y + 4$
3. $4n + 8$, 0
4. $8x^2 - 5x$
5. $k = 5$
6. $5a - 5b + 6$
7. $6x + 2y + 4$
8. $-5p^2 + 2p - 5$
9. $10x - 11y + 22$
10. $6x + 2y + 10$
11. $a = 5$, $b = 9$, $c = -9$

Chapter 3 Answer Key - Expanding Brackets

Skill Practice

1. $2x + 6$
2. $3x + 15$
3. $4a + 8$
4. $5n + 5$
5. $6p + 24$
6. $7y - 14$
7. $8m - 24$
8. $6x + 3$
9. $12a + 8$
10. $10p - 15$
11. $8y - 14$
12. $18n + 30$
13. $9x - 36$
14. $10a + 60$
15. $15m - 6$
16. $-2x - 6$
17. $-3a + 12$
18. $-8x - 20$
19. $-15y + 10$
20. $-2x + 14$
21. $-6a - 15$
22. $6m - 8$
23. $6p + 18$
24. $-x + 8$
25. $-12n - 3$
26. $x^2 + 3x$
27. $x^2 - 5x$
28. $2x^2 + 8x$
29. $6x^2 - 3x$
30. $-x^2 - 2x$
31. $-2x^2 + 6x$
32. $a^2 + 6a$
33. $4a^2 - 8a$
34. $3p^2 + 5p$
35. $-6p^2 + 12p$
36. $7x + 6$
37. $7a - 6$
38. $3y + 5$
39. $9x - 12$
40. $5m + 8$
41. $x + 10$
42. $2a + 12$
43. $-5p - 3$
44. $7n - 14$
45. $x + 16$
46. $4x + 8$
47. $5x + 15$
48. $6x + 30$
49. $3x + 21$
50. $2y - 8$
51. $4x + 16$
52. $10x - 5$
53. $7a - 21$
54. $-2x + 8$
55. $6x + 15$
56. $6x - 18$
57. $-8x - 20$
58. $2a - 19$
59. $5p^2 - 10p$
60. $-6x^2 + 21x$
61. $11x - 3$
62. $-2y - 11$
63. $12x - 8$

Skill Practice

1. $2(x + 3)$
2. $3(x + 4)$
3. $4(a - 2)$
4. $5(2p + 1)$
5. $6(3y - 4)$
6. $7(m + 2)$
7. $8(2n + 3)$
8. $9(x - 5)$
9. $10(a + 6)$
10. $2(5p - 7)$
11. $x(x + 4)$
12. $2x(x + 3)$
13. $3a(a - 4)$
14. $4p(2p + 1)$
15. $5m(m - 2)$
16. $y(3y + 7)$
17. $6x(x - 1)$
18. $2a(3a + 5)$
19. $4n(n + 3)$
20. $3p(2p - 5)$
21. $2(x + y)$
22. $3(a - b)$
23. $4(2m + n)$
24. $5(p + q)$
25. $6(2x - 3y)$
26. $7(a + 2b)$
27. $3(4m + 5n)$
28. $2(6p - q)$
29. $5(3x - 2y)$
30. $4(a + b + 2)$
31. $-2(x + 3)$
32. $-3(a - 4)$
33. $-4(x - 5)$
34. $-5(p + 3)$

Exam-Style Structured Practice

1. $4x + 28$, 36
2. $8x + 24$
3. $6x + 12$

4. $5x + 10$
5. $-6x + 6$
6. $-3x - 6$
7. $2x^2 + 10x$
8. $x^2 + 5x$
9. $5x + 20$
10. $k = 5$
11. $7a - 8$
12. $9p + 18$
13. $6x + 1$
14. $-4x + 7$
15. $x + 18$
16. $5x + 10$
17. $10a^2 - 15a$
18. $-6m^2 - 8m$
19. $c = 7$
20. Yes; both simplify to $5x + 10$
21. -14

Mixed Review

1. $3a$
2. 13
3. $11x$
4. $3x + 6$
5. 10
6. $2a + 3b$
7. $-2y + 8$
8. $6p^2$
9. $x^2 + 6x$
10. $3x + 2$
11. $2n - 5$

Challenge Questions

1. $x^2 + 7x + 12$
2. $x^2 - 3x - 10$
3. $2x^2 - 5x - 12$
4. $k = 6$
5. $-x + 18$
6. $x^2 + 7x + 10$
7. $-6x + 10$
8. $x^2 + 2x + 6$
9. $x^2 - x - 30$
10. $6x^2 + 17x - 14$
11. $5x - 14$, -19

Chapter 4 Answer Key - Factorising Expressions

Skill Practice

1. $2(x + 3)$
2. $3(x + 4)$
3. $4(a - 2)$
4. $5(2p + 1)$
5. $6(3y - 4)$
6. $7(m + 2)$
7. $8(2n + 3)$
8. $9(x - 5)$
9. $10(a + 6)$
10. $2(5p - 7)$
11. $x(x + 4)$
12. $2x(x + 3)$
13. $3a(a - 4)$
14. $4p(2p + 1)$
15. $5m(m - 2)$
16. $y(3y + 7)$
17. $6x(x - 1)$
18. $2a(3a + 5)$
19. $4n(n + 3)$
20. $3p(2p - 5)$
21. $2(x + y)$
22. $3(a - b)$
23. $4(2m + n)$
24. $5(p + q)$
25. $6(2x - 3y)$
26. $7(a + 2b)$
27. $3(4m + 5n)$
28. $2(6p - q)$
29. $5(3x - 2y)$
30. $4(a + b + 2)$
31. $-2(x + 3)$
32. $-3(a - 4)$
33. $-4(x - 5)$
34. $-5(p + 3)$

35. $-2x(x - 4)$
36. $-3a(a + 2)$
37. $-x(x - 7)$
38. $-6m(m - 2)$
39. $-4p(p + 5)$
40. $-8(x + 2y)$
41. $(x + 2)(x + 3)$
42. $(x + 5)(x + 2)$
43. $(x + 4)(x + 5)$
44. $(x + 2)(x + 4)$
45. $(x - 2)(x - 3)$
46. $(x - 3)(x - 4)$
47. $(x - 3)(x + 2)$
48. $(x + 4)(x - 3)$
49. $(x - 3)(x + 3)$
50. $(x - 4)(x + 4)$
51. $(x + 5)(x - 3)$
52. $(x - 6)(x + 2)$
53. $(x + 3)(x + 7)$
54. $(x - 5)(x - 6)$
55. $(x - 5)(x + 5)$
56. $(x - 7)^2$
57. $(x + 6)^2$
58. $(x - 7)(x + 5)$
59. $(x + 8)(x - 5)$
60. $2x(x + 4)$
61. $3(x - 3)(x + 3)$
62. $4(x + 2)(x + 3)$
63. $3x(2x + 5)$
64. $(x + 8)(x - 3)$
65. $(x - 4)(x + 4)$
66. $2(x - 3)(x + 3)$
67. $(x - 7)(x + 4)$
68. $3(x + 2)^2$
69. $(2x - 3)(2x + 3)$
70. $2(x + 3)(x + 4)$
71. $(x - 3)(x - 7)$
72. $(x + 8)(x - 6)$
73. $5x(x - 4)$
74. $(x - 9)(x + 9)$
75. $3(x - 5)(x + 1)$
76. $2(x + 4)(x + 5)$
77. $(3x - 4)(3x + 4)$
78. $(x + 9)(x - 8)$
79. $(x - 9)(x + 5)$
80. $(x + 6)(x + 9)$
81. $6x(x + 5)$
82. $2(x - 5)(x + 5)$
83. $(x - 11)(x + 11)$
84. $4(x + 3)(x - 2)$
85. $3(x + 6)(x - 5)$
86. $(5x - 1)(5x + 1)$

Exam-Style Structured Practice

1. $6(x + 3)$
2. $4(3a - 2)$
3. $x(x + 9)$
4. $5x(x - 4)$
5. $x + 4$
6. $4(x + y)$
7. $3(2a - 3b)$
8. $(x + 2)(x + 4)$
9. $(x - 5)(x - 2)$
10. $2(x + 3)$
11. $-3(x + 4)$
12. $2(x + 2)(x + 3)$
13. $k = 7$
14. $(x + 3)(x + 4)$
15. $4(2x + 5)$
16. $3p(3p - 2)$
17. $(x - 7)(x + 7)$
18. $(x - 5)(x + 4)$
19. $6(2m + 3n)$
20. $5(x + y + 2)$
21. $3(x + 5)$, 21

Mixed Review

1. $5a$
2. $7x$
3. $2x + 10$
4. $2(x + 5)$
5. 11

6. $2a + 3b$
7. $-3y + 6$
8. $x(x + 4)$
9. $(x + 1)(x + 2)$
10. $x^2 + 6x$
11. $2n + 4$

Challenge Questions

1. $(x - 7)(x + 5)$
2. $(x + 6)(x + 7)$
3. $2x(x + 5)$
4. $3x(2x + 3)$
5. $(x - 8)(x + 8)$
6. $4(x - 3)(x + 3)$
7. $k = 11$
8. $(x + 2)(x + 3)$ E1. $x^2 - 8x + 15 = 0$
E2. Sum 7, product 12; roots 3 and 4 E3. $(x - 4)(x - 5)$ E4. $k = -9$ E5. $x^2 - 5x - 14 = 0$ E6. Sum 5, product 6; roots 2 and 3 E7. Other root 7; $x^2 - 11x + 28 = 0$ E8. $x^2 - 13x + 36 = 0$ E9. $m = 24$ E10. $p = 4$, $q = -12$; roots 2 and -6

Chapter 5 Answer Key - Linear Equations

Skill Practice

1. $x = 7$
2. $x = 12$
3. $x = -2$
4. $x = 0$
5. $x = 15$
6. $x = -6$
7. $x = 21$
8. $x = 4$
9. $x = 9$
10. $x = 3$
11. $x = -5$
12. $x = 14$
13. $x = 0$
14. $x = -7$
15. $x = 20$
16. $x = 3$
17. $x = 5$
18. $x = -2$
19. $x = 8$
20. $x = -6$
21. $x = 4$
22. $x = 7$
23. $x = -9$
24. $x = 6$
25. $x = 8$
26. $x = -5$
27. $x = 9$
28. $x = 12$
29. $x = -7$
30. $x = 10$
31. $x = 7$
32. $x = 4$
33. $x = -2$
34. $x = 6$
35. $x = 3$
36. $x = -4$
37. $x = 5$
38. $x = 0$
39. $x = 4$
40. $x = -1$
41. $x = 12$
42. $x = -3$
43. $x = 8$
44. $x = -2$
45. $x = 7$
46. $x = 6$
47. $x = -1$
48. $x = 3$
49. $x = 9$
50. $x = -5$
51. $x = 8$
52. $x = 4$
53. $x = 3$
54. $x = -2$

55. $x = 5$
56. $x = -3$
57. $x = 2$
58. $x = 4$
59. $x = -1$
60. $x = 6$
61. $x = 4$
62. $x = 7$
63. $x = -1$
64. $x = 2$
65. $x = 8$
66. $x = 3$
67. $x = -1$
68. $x = 7$
69. $x = 8$
70. $x = 11$
71. $x = -7$
72. $x = 12$
73. $x = 9$
74. $x = 9$

Exam-Style Structured Practice

1. $x = 6$
2. $x = 9$
3. $x = -5$
4. $x = 9$
5. $x = 11$
6. $x = 7$
7. $x = 5$
8. $x = 17$
9. $x = 8$
10. 9
11. $x = 6$
12. $x = 30$
13. 18
14. $x = 9$
15. $x = 6$
16. $x = 9$
17. $x = -4$
18. $x = 24$
19. $x = 6$
20. $x = 9$
21. $x = 7$
22. $x = 9$
23. $x = 7$
24. Yes
25. $x = 6$

Mixed Review

1. $6a$
2. $13x$
3. $3x + 12$
4. $3(x + 4)$
5. $x = 12$
6. $x = 6$
7. 10
8. $5a + 3b$
9. $-2x + 12$
10. $x = 7$
11. $x(x + 6)$
12. $x = 5$
13. $n - 4$
14. $(x + 2)(x + 3)$

Challenge Questions

1. $x = 10$
2. $x = 9$
3. $x = 4$
4. $x = 13$
5. $x = 7$
6. $x = 6$
7. $x = 12$
8. $x = 11$
9. $x = 7$
10. $x = 7$
11. 11
12. $x = 9$

Chapter 6 Answer Key - Inequalities

Skill Practice

1. x is greater than 3
2. x is less than or equal to -2

3. open circle at 4, shade left
4. closed circle at 1, shade right
5. $\leq$ and $\geq$
6. true
7. $x < 7$
8. $x \geq 7$
9. $x \leq -4$
10. $x > -4$
11. $x \geq -7$
12. $x < 12$
13. $x > -6$
14. $x \leq -6$
15. $x < 0$
16. $x \geq 12$
17. $x < 5$
18. $x \geq -4$
19. $x \leq 5$
20. $x > -2$
21. $x \leq 12$
22. $x > -10$
23. $x \geq 18$
24. $x < 0$
25. $x \geq 7$
26. $x \leq -2$
27. $x > -3$
28. $x \leq -4$
29. $x > -5$
30. $x \geq 5$
31. $x < -3$
32. $x \leq 3$
33. $x > -8$
34. $x \geq 6$
35. $x < 4$
36. $x \geq 5$
37. $x \leq -2$
38. $x > 5$
39. $x > -4$
40. $x \leq -5$
41. $x \geq 4$
42. $x < 3$
43. $x > 2$
44. $x \leq -1$
45. $x < 5$
46. $x \geq 0$
47. $x \leq 6$
48. $x > 5$
49. $x > -4$
50. $x \leq -4$
51. $x \leq 6$
52. $x < -3$
53. $x \leq 4$
54. $x > -2$
55. $x \leq 5$
56. $x > 3$
57. $x \geq 5$
58. $x \geq -1$
59. $x < 6$
60. $x \geq -5$
61. -1, 0, 1, 2, 3
62. $x > 4$

Exam-Style Structured Practice

1. $x < -6$; open circle at -6, shade left
2. $x \geq -6$; closed circle at -6, shade right
3. $x > -3$
4. $x \geq -4$
5. $x \leq -5$
6. 6 wins
7. $x > -3$
8. -2, -1, 0, 1, 2
9. -3, -2, -1, 0, 1
10. $x > 5$
11. $x \leq 4$
12. $x > 3$
13. $x \geq -10$
14. $x > -12$
15. $x \leq 6$
16. $x \geq 18$
17. $d \leq 12$
18. $x < -6$

Mixed Review

1. $5a$
2. $11x$
3. $4x - 8$
4. $4(x - 2)$
5. $x = 6$
6. $x < 6$
7. 11
8. $(x + 5)(x + 2)$
9. closed circle at 4, shade left
10. $x = 4$

Challenge Questions

1. $1 < x \leq 5$
2. $1 \leq x < 5$
3. 0, 1, 2, 3
4. $\frac{1}{2} < x \leq \frac{22}{3}$
5. $x \leq 1$
6. $k = -3$
7. $-5 < x \leq 5$
8. $4x - 12 \geq -4$; $x \geq 2$
9. $x > -2$
10. -3, -2, -1, 0

Chapter 7 Answer Key - Formulae and Rearranging

Year 10 Changing Subject Practice

1. $x = \frac{2y+5}{3}$
2. $x = \frac{4+11}{6}$
3. $q = ps - r$
4. $b = \frac{2S}{h} - a$
5. $F = \frac{9C}{5} + 32$
6. $x = \frac{u-c}{\frac{m}{v^2-u^2}}$
7. $a = \frac{v^2-u^2}{2s}$
8. $y_2 = m(x_2 - x_1) + y_1$

Skill Practice

1. 22
2. 56
3. 23
4. 25
5. 48
6. 54
7. 23
8. 26
9. 50
10. 48
11. 17
12. 36
13. 22
14. 18
15. 29
16. -13
17. -2
18. 18
19. 23
20. 8
21. 4
22. 16
23. 21
24. 25
25. 60
26. $x = y - 9$
27. $x = y + 6$
28. $x = \frac{4}{5}$
29. $q = \frac{2}{7}$
30. $n = 4m$
31. $x = 6y$
32. $r = \frac{C}{2}$
33. $h = \frac{V}{A}$
34. $s = \frac{d}{t}$
35. $m = \frac{E_a}{v}$
36. $s = \frac{p}{4}$
37. $k = 3C$
38. $x = \frac{u-5}{3}$
39. $x = \frac{u+7}{4}$
40. $q = \frac{u-3}{2}$
41. $b = \frac{A+10}{5}$
42. $x = 3T - 4$
43. $n = 5M + 2$
44. $a = \frac{C}{2} - b$
45. $l = \frac{P^2-2w}{2}$
46. $x = \frac{u-b}{a}$

47. $t = \frac{u-v}{a}$
48. $u = \frac{a-v}{a}$
49. $d = \frac{F-3c}{2}$
50. $b = -8$
51. $l = -9$
52. $t = 7$
53. $m = -9$
54. $x = -6$
55. $a = -8$
56. $h = -9$
57. $r = \frac{C}{2\pi}$
58. $w = -4$
59. $x = \frac{y+8}{5}$
60. $p = 4q + 3$
61. $b = -5$
62. $a = 2m - b$
63. $s = -13$
64. 43
65. 15
66. 28
67. $x^2 = \frac{y+4}{5}$
68. $x = \frac{8-y}{3}$
69. $x = -6$
70. 19
71. 27
72. $x = \frac{7-y}{2}$
73. $x = \frac{5-p}{4}$
74. $x = -6$
75. 12
76. $x^2 = \frac{A-9}{2}$
77. $x = 6$
78. 9

Exam-Style Structured Practice

1. (a) 60 (b) $l = \frac{A}{w}$ (c) 12
2. (a) 26 (b) $l = \frac{P-2w}{2}$ (c) 15
3. (a) 22 (b) $x = \frac{y-4}{3}$ (c) 9
4. (a) 34 (b) $t = \frac{u-v}{a}$ (c) 5
5. (a) 38 (b) $n = \frac{C+2}{5}$ (c) 13
6. (a) 23 (b) $q = \frac{S-2p}{3}$ (c) 9
7. (a) 120 (b) $h = \frac{V}{lw}$ (c) 4
8. (a) 11 (b) $b = 2m - a$ (c) 17
9. (a) 13 (b) $y = \frac{4s-T}{3}$ (c) 4
10. (a) 21 (b) $n = \frac{E}{3} - 2$ (c) 13
11. (a) 6 (b) $p = 4q + 5$ (c) 49
12. (a) 35 (b) $h = \frac{2A}{b}$ (c) 8
13. (a) 5 (b) $x = 5y - 7$ (c) 53
14. (a) 18 (b) $a = \frac{R}{2} + b$ (c) 22
15. (a) 27 (b) $x = \frac{N-c}{k}$ (c) 8
16. (a) 60 (b) $t = \frac{D}{k}$ (c) 12
17. (a) 26 (b) $s = \frac{P-6}{4}$ (c) 12
18. (a) 32 (b) $y = \frac{H-2x-4}{3}$ (c) 10
19. (a) 30 (b) $r = \frac{100}{pt}$ (c) 4
20. (a) 19 (b) $m = \frac{y-c}{x}$ (c) 4
21. (a) 48 (b) $b = \frac{C}{a} - c$ (c) 7

Mixed Review

1. $11x$
2. $3x + 15$
3. $6(x + 2)$
4. $x = 6$
5. $x < 5$
6. 13
7. $8r$
8. $(x + 3)(x + 5)$
9. $-2x + 12$
10. $x = 17$
11. 17

Challenge Questions

1. (a) $h = \frac{2A}{a+b}$ (b) 12
2. (a) $s = \frac{v^2-u^2}{2a}$ (b) 12
3. (a) $r = \frac{C}{2\pi}$ (b) $A = \frac{C^2}{4\pi}$
4. (a) $x = \frac{T+11}{6}$ (b) 8
5. (a) $a = \frac{5M+3k}{2}$ (b) $\frac{4t}{2}$
6. $w = 10$, $l = 15$
7. $k = 3$, $c = 1$, $y = 3x + 1$
8. (a) $n = \frac{N-a}{d} + 1$ (b) 11
9. $x = \frac{4+1}{3}$
10. $w = 10$
11. $h = \frac{3V}{A}$
12. (a) $n = \frac{C-12}{5}$ (b) 15
13. $x = \frac{M+17}{8}$

14. $b = 12$
15. $b = y - mx$
16. $q = \frac{v+2r}{3}$
17. (a) $n = \frac{T+5}{10}$ (b) 8

Chapter 8 Answer Key - Sequences

Skill Practice

1. 15, 18
2. 21, 25
3. 8, 5
4. 162, 486
5. 6, 3
6. 25, 36
7. 26, 37
8. 15, 21
9. 112, 224
10. 20, 15
11. 28, 39
12. 17, 23
13. 5, 8, 11, 14, 17
14. 4, 9, 14, 19, 24
15. 35
16. 68
17. 33
18. 37
19. 1, 4, 9, 16, 25
20. 2, 4, 8, 16
21. 42
22. 6
23. 17, 14, 11, 8, 5
24. 23
25. $3n + 1$
26. $5n$
27. $4n + 5$
28. $7n - 5$
29. $3n - 4$
30. $14 - 2n$
31. $23 - 3n$
32. $5n + 1$
33. $5n - 4$
34. $4n - 8$
35. $105 - 5n$
36. $7n + 1$
37. $8n - 5$
38. $2n$
39. $10n$
40. $3n - 3$
41. the 9th term
42. the 9th term
43. Yes, it is the 15th term.
44. No.
45. $n = 12$
46. the 8th term
47. the 10th term
48. the 4th term
49. 7, 10, 13, 16
50. 10, 8, 6, 4
51. 25
52. pattern 7

Exam-Style Structured Practice

1. (a) add 4 (b) 22, 26 (c) $4n + 2$ (d) 82
2. (a) $7n + 5$ (b) 110 (c) 13th
3. (a) $55 - 5n$ (b) 15 (c) 11th
4. (a) 4, 7, 10, 13, 16 (b) 61 (c) pattern 21
5. (a) $3n + 1$ (b) 37 (c) pattern 16
6. (a) $3n - 5$ (b) 85 (c) 16th
7. (a) $3n + 2$ (b) 77 (c) 20th
8. (a) 13 (b) $6n + 1$ (c) 61
9. (a) 1, 5, 9, 13 (b) yes, 16th (c) 12th
10. (a) \$12, \$17, \$22, \$27 (b) $5n + 7$ (c) \$57
11. (a) 7, 10, 13 (b) 58 (c) 25th
12. (a) 3, 6, 11, 18, 27 (b) 102 (c) yes, 8th
13. (a) $6n + 2$ (b) 74 (c) pattern 12
14. (a) $A_4 = 13$, $B_4 = 17$ (b) $n = 8$ (c) 25
15. $n = 7$; $A_7 = 33$, $B_7 = 31$
16. (a) $15 - 4n$ (b) -9 (c) 11th
17. (a) $4n - 1$ (b) 3, 7, 11, 15 (c) 12
18. (a) $a = 5$, $b = -1$ (b) 59
19. (a) 4 (b) $4n + 2$ (c) 82

20. (a) 1, 7, 17, 31 (b) 71 (c) yes, 5th

Mixed Review

1. $8x$
2. $5x - 15$
3. $9(x + 2)$
4. $x = 6$
5. $x \leq 4$
6. $x = \frac{x-5}{2}$
7. 7
8. $(x + 2)(x + 4)$
9. $3n + 2$
10. $x = 13$
11. $-6x - 3$

Challenge Questions

1. (a) $n^2 + 5n - 1$ (b) 149
2. pattern 7, with 29 sticks
3. first term 2, nth term $5n - 3$, 100th term 497
4. $n = 7$, equal term 29
5. (a) 21 (b) pattern 9
6. (a) 22 terms (b) 847
7. (a) 226 (b) 12th

Chapter 9 Answer Key - Straight-Line Graphs

Skill Practice

1. points $A(2, 3)$, $B(-1, 4)$, and $C(0, -2)$ plotted correctly
2. Quadrant II
3. (0, -4)
4. (5, 0)
5. 2, 3, 4, 5
6. 1, 3, 5, 7
7. -1, 2, 5, 8
8. 4, 3, 2, 1
9. 5, 4, 3, 2
10. -5, -3, -1, 1
11. 6, 4, 2, 0
12. -4, 0, 4, 8
13. 1, 2, 3, 4
14. 4, 3, 2, 1
15. 1, 3, 5, 7
16. 4, 1, -2, -5
17. 2
18. 2
19. 3
20. 0
21. -1
22. 2
23. -3
24. $\frac{1}{2}$
25. $\frac{1}{2}$
26. -2
27. 0
28. 3
29. 2
30. 3
31. -1
32. -6
33. gradient -3, y -intercept 2
34. gradient $\frac{1}{2}$, y -intercept -4
35. $y = 3x + 2$
36. $y = -2x + 5$
37. $y = \frac{1}{2}x - 1$
38. $y = 2x + 4$
39. $y = -x - 3$
40. $y = 5x$
41. x -intercept (4, 0), y -intercept (0, 8)
42. x -intercept (4, 0), y -intercept (0, -6)
43. $y = -x + 7$; x -intercept (7, 0)
44. $y = -\frac{1}{3}x + 1$; y -intercept (0, 1)
45. (0, 1), (1, 2), (2, 3)
46. (-1, -2), (0, 0), (1, 2)
47. $y = 2x + 1$
48. $y = -x + 6$
49. $y = 3x + 11$
50. $y = \frac{1}{2}x - 4$
51. $y = -3x + 5$
52. 0
53. $x = 3$
54. $y = -2$
55. $y = 5x + 1$
56. Yes.

57. No.
58. 10
59. 5
60. 11
61. 6
62. Yes.
63. gradient -5, y -intercept 8
64. 3
65. $y = 4x - 6$
66. (2, 5)
67. (5, 0)
68. A: 1, B: 2, C: -1, D: $-\frac{1}{2}$, E: 0, F: 0, G: undefined, H: undefined
69. (a) x -intercept (4, 0), y -intercept (0, -8) (b) x -intercept (2, 0), y -intercept (0, 6) (c) x -intercept (-6, 0), y -intercept (0, 3) (d) x -intercept (10, 0), y -intercept (0, 4) (e) x -intercept (4, 0), y -intercept (0, -3) (f) $y = 2x - 2$ (g) $y = -x + 3$ (h) $y = \frac{1}{2}x - 3$ (i) $y = -\frac{1}{2}x + 3$ (j) $y = \frac{1}{2}x - 3$ (k) $y = -2x + 2$ (l) $y = 4x - 35$

Exam-Style Structured Practice

1. (a) 3, 5, 7, 9 (b) 2 (c) 3
2. (a) 4, 3, 2, 1, 0 (b) 4 (c) (4, 0)
3. (a) 2 (b) $y = 2x + 2$ (c) yes
4. (a) $y = -2x + 6$ (b) (3, 0) (c) 8
5. (a) 3 (b) $y = 3x + 1$ (c) 19
6. (a) -2 (b) $y = -2x + 3$ (c) ($\frac{3}{2}$, 0)
7. (a) 3 (b) -4 (c) 11
8. (a) $y = 4x + 6$ (b) yes
9. (4, 9)
10. (2, 5)
11. (a) 5 (b) 3 per km (c) 29
12. (a) 12 (b) 20, starting cost (c) 92
13. (a) 2 (b) $y = 2x$ (c) 18
14. $y = 3x - 2$
15. $y = 2x + 5$
16. (-2, 3)
17. (a) $y = -3x - 4$ (b) 2
18. $y = x - 6$: (6, 0); $y = 2x - 6$: (3, 0); $y = 2x - 6$ first
19. (a) $m = 2$, $c = 5$ (b) $x = 13$
20. (a) 2, 3, 4, 5 (b) $\frac{1}{2}$ (c) 6
21. (a) $k = 4$ (b) 44 (c) 15
22. The student used the gradient as the intercept; gradient 2, y -intercept 3.
23. (a) 5 (b) -10 (c) (2, 0) (d) yes

Mixed Review

1. $12x$
2. $4x - 8$
3. $5(2x + 3)$
4. $x = 6$
5. $x > 3$
6. $x = \frac{y+4}{5}$
7. $4n - 2$
8. -4
9. Yes.
10. 29
11. $(x + 4)(x + 5)$
12. the 13th term
13. 6

Challenge Questions

1. (a) (3, 9) (b) yes
2. (a) $y = \frac{1}{2}x + 2$ (b) $x = 14$
3. $k = -2$
4. (a) $k = 4$ (b) ($-\frac{1}{2}$, 0)
5. $a = 1$, $y = 3x + 1$
6. $d = 3$, equal cost 16, Plan B is cheaper for $d = 1$
7. $y = 3x + 3$, y -intercept 3
8. $P = (3, 7)$; yes
9. $y = 3x - 3$, x -intercept (1, 0)
10. $a = 0$, intersection (3, 6)
11. $d = 3$, equal cost 24, Plan A is cheaper when $d = 5$

Chapter 10 Answer Key - Algebra Mixed Review

Skill Practice

1. $3ab$

2. x^2y
3. 19
4. 14
5. 15
6. 49
7. 45
8. 22
9. $11x$
10. $6a$
11. $8p + q$
12. $4x + 3y$
13. $6m - 4$
14. $4a - 5b$
15. $15x + 6$
16. $9r - 5s$
17. $8a$
18. $6x$
19. $3x + 12$
20. $5a - 10$
21. $-2x - 12$
22. $-3y + 15$
23. $8x + 4$
24. $6a - 14$
25. $x^2 + 5x$
26. $3x^2 - 12x$
27. $3x + 6$
28. $2x - 4$
29. $6(x + 2)$
30. $5(2a - 3)$
31. $(x + 2)(x + 3)$
32. $(x + 4)(x + 5)$
33. $(x - 4)(x + 3)$
34. $(x - 4)(x + 4)$
35. $3x(x + 2)$
36. $4y(y - 3)$
37. $(2x + 1)(x + 3)$
38. $3(x - 2)(x + 2)$
39. $x = 8$
40. $x = 7$
41. $x = 7$
42. $x = 30$
43. $x = 6$
44. $x = 5$
45. $x = 6$
46. $x = 9$
47. $x = 6$
48. $x = 20$
49. $x = 12$
50. $x = 7$
51. $x < 7$
52. $x \geq 13$
53. $x \leq 7$
54. $x > 4$
55. $x > -4$
56. $x \geq 6$
57. $x < 6$
58. $x \geq -4$
59. 17
60. 42
61. $x = \frac{y+1}{4}$
62. $h = \frac{V}{A}$
63. $l = 12$
64. $a = 4$
65. $5n - 1$
66. 38
67. -2
68. -7
69. 2
70. (3, 5)
71. $7x + 4y - 4$
72. $5x - 27$
73. $3x(x + 4)$
74. $x = 7$
75. $x \leq -4$
76. $r = \sqrt{\frac{4}{\pi}}$
77. $14 - 3n$
78. (3, 5)
79. $5a - 3b + 9$
80. $-x + 8$
81. $(x + 5)(x + 6)$
82. $x = 9$

83. $x < 8$
84. $m = \frac{E}{a}$
85. 86
86. (4, 10)

Exam-Style Structured Practice

1. (a) $6a$ (b) 29 (c) $4mn$
2. (a) $3x - 15$ (b) $6(y + 3)$ (c) $x = 5$
3. $x = 9$
4. $x > -4$; open circle at -4 , shade right
5. (a) 72 (b) $w = \frac{4}{7}$ (c) 6
6. (a) $4n + 3$ (b) 83 (c) 24th
7. (a) $-3, -1, 1$ (b) 2 (c) $(\frac{3}{2}, 0)$
8. $(x + 3)(x + 4)$; $x = -3, -4$
9. (4, 13)
10. (a) $x = 13$ (b) $y = 27$
11. (a) $n = 4$ (b) 13 (c) $n \geq 5$
12. (a) 3 (b) $y = 3x + 4$ (c) 19
13. (a) $-x + 12$ (b) $x = 7$
14. (a) $4(2x - 5)$ (b) $(x - 5)(x + 5)$
15. (a) $x = 6$ (b) $x > 6$
16. $b = \frac{C-2a}{3}$; $b = 7$
17. (a) 3, 8, 13, 18 (b) 14th
18. (a) yes (b) no (c) 2
19. (a) 34 (b) 11
20. (a) $2x(x + 5)$ (b) $x = 0, -5$
21. (a) $8t + 6 \leq 54$ (b) 6
22. gradient -3 , y -intercept (0, 9), x -intercept (3, 0)
23. (a) 5, 9, 13, 17 (b) pattern 11
24. $x = 4y + 3$; $x = 27$
25. $a = 6$; 26
26. (a) 3 (b) $y = 3x - 1$ (c) 7

Mixed Review

1. $6pq$
2. $-x$
3. $6x - 10$
4. $4(3x + 2)$
5. $x = 15$
6. $x < -5$
7. $t = \frac{d}{r}$
8. $7n - 1$
9. 15
10. 3
11. 8
12. $(-6, 0)$
13. $(x + 5)(x - 2)$
14. 16

Challenge Questions

1. (3, 11)
2. $k = 4$; x -intercept $(-\frac{3}{4}, 0)$
3. $x = 6$; area 99
4. first term 6, n th term $4n + 2$, 100th term 402
5. $(x + 7)(x - 5)$; $x = -7, 5$
6. $x \leq 7$; positive integers
1, 2, 3, 4, 5, 6, 7
7. $n = 6$, equal cost 30, Plan B cheaper at $n = 4$
8. $c = 3$, $y = 3x + 3$, x -intercept $(-1, 0)$
9. $5b + 3$; 23
10. 8th term 80; 48 is the 6th term
11. $k = 5$, $y = 3x - 1$
12. $(x - 5)(x + 4)$; $x = 5, -4$
13. $a = 4$, $b = 1$; 25th term 101

Junior Maths - Algebra - Quality Check Report

Current Production Status

Chapters 1-10 are drafted, verified, and included in the question bank. Book 04 is a complete publication draft pending human editorial review and print proofing.

Book 04 Question Counts

Chapter	Verified Questions
chapter-01-algebraic-notation-and-substitution	282
chapter-02-collecting-like-terms	106
chapter-03-expanding-brackets	106
chapter-04-factorising-expressions	136
chapter-05-linear-equations	125
chapter-06-inequalities	100
chapter-07-formulae-and-rearranging	135
chapter-08-sequences	90
chapter-09-straight-line-graphs	116
chapter-10-algebra-mixed-review	139

| Total | 1335 |

Chapter 10 Distribution

Category	Count
Skill Practice	86
Exam-Style Structured Practice	26
Mixed Review	14
Challenge Questions	13
Easy	8
Medium	92
Hard	26
Challenge	13
drill type	8
structured type	78
exam-style type	26
mixed-review type	14
challenge type	13

Verification Report

- Simplification, expansion, and factorising answers were checked by reverse expansion or coefficient comparison.
- Vieta theorem extension questions were checked using root sum/product rules and reverse expansion.
- Equation, inequality, and quadratic-equation answers were checked by substitution, boundary testing, reverse factorisation, the quadratic formula, or completing-the-square reversal.
- Equation application questions were checked by forming the stated equation, solving it, and substituting the result back into the context.
- Fractional algebra questions were checked by factorising, cancelling only common factors, and reversing by multiplication where appropriate.
- Fractional speed-distance-time equations were checked using $t = \frac{d}{s}$, substitution, and rejection of impossible negative speeds.
- Formula questions were checked by rearranging with inverse operations and substituting back.
- Sequence questions were checked by substituting term positions into the nth-term rule.
- Graph questions were checked using gradient, intercept, point substitution, or intersection equations.
- Challenge questions were checked by independent recomputation and exact arithmetic.

Human Review

All produced Book 04 questions are mechanically verified. Human editorial review and print proofing are still required before KDP publication.