

PRACTICE WORKSHEET + FULL ANSWER KEY

Linear equations and graphs

Secondary mathematics. Work through the sections in order, or choose the one that matches this week's topic.

QUESTIONS	SECTIONS	ANSWER KEY	WORKING SPACE
104	10	At the back	Ruled

Name _____ Class _____ Date _____

Before you start

An equation states that two quantities are equal. Apply the same operation to both sides. On a graph, the solution to a system is the point that satisfies both equations.

WORKED EXAMPLE

Solve $3x + 7 = 22$.

- 1 Subtract 7 from both sides: $3x = 15$.
- 2 Divide both sides by 3: $x = 5$.
- 3 Check: $3(5) + 7 = 22$.

Use this method as your model. Set out your own working the same way.

Common mistakes to avoid

- Changing only one side of an equation
- Confusing the y-intercept with the gradient

There are 104 questions across 10 sections. Write in the ruled space, then mark your work against the answer key at the back. Topics covered: Solving equations, Gradient and intercept, Systems of equations.

SECTION A Expressions and expanding

Collect like terms only, and keep the sign that sits in front of each term.

1

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

3

Expand $3(x + 4)$.

2

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

4

Expand $-2(x - 5)$.

5

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

6

Factorise $6x + 15$.

7

Factorise $8y - 12$.

8

Evaluate $3x - 7$ when $x = 4$.

9

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

10

Write an expression for five more than triple a number n .

11

Simplify $12x/4$.

SECTION B Solving linear equations

Do the same thing to both sides. Substitute your answer back in to check it.

12

Solve $4x - 9 = 19$.

13

Solve $2(x + 3) = 18$.

14

Solve $5x + 4 = 3x + 16$.

15

Solve $x/3 + 2 = 7$.

16

Solve $7 - 2x = 1$.

17

Solve $3(2x - 1) = 4x + 7$.

18

Solve $(x + 5)/2 = 6$.

19

Solve $-3x = 21$.

20

Make y the subject of $2x + y = 10$.

21

Make x the subject of $y = 3x - 6$.

22

Solve $0.5x + 1.5 = 4$.

SECTION C Straight-line graphs

Gradient is the change in y divided by the change in x . The y -intercept is the value of y when $x = 0$.

- 23 Find the gradient of the line through (1, 3) and (4, 9).

- 24 Find the gradient of the line through (-2, 5) and (2, -3).

- 25 State the gradient and the y -intercept of $y = 4x - 5$.

- 26 Find y when $x = 3$ in $y = 2x - 1$.

- 27 Find x when $y = 0$ in $y = 2x - 8$.

- 28 Write the equation of the line with gradient 3 passing through (0, -2).

- 29 Write the equation of the line through (0, 4) and (2, 10).

- 30 Does the point (2, 7) lie on $y = 3x + 1$? Show why.

- 31 Rearrange $2x + y = 6$ into the form $y = mx + c$.

- 32 Two lines have gradient 5 but different intercepts. What do you know about them?

- 33 Sketch $y = -x + 3$ and state where it crosses each axis.

SECTION D Simultaneous equations and inequalities

Eliminate one variable or substitute. Always state both values in your answer.

- 34 Solve $y = 2x + 1$ and $y = -x + 7$.

- 35 Solve $x + y = 10$ and $x - y = 4$.

- 36 Solve $2x + y = 11$ and $x - y = 1$.

- 37 Solve $3x + 2y = 16$ and $x = y + 2$.

- 38 Solve $4x - 3y = 5$ and $2x + y = 5$.

- 39 Solve the inequality $3x + 2 < 14$.

- 40 Solve the inequality $5 - 2x \geq 1$.

41

Show $2 < x \leq 6$ on a number line. Describe your marks.

42

List the integer solutions of $-2 \leq x < 3$.

43

Explain what happens to an inequality when both sides are divided by -1 .

44

Two numbers add to 20 and differ by 6. Find them.

SECTION E Modelling and reasoning

Define your variable first. Finish with a sentence that answers the question asked.

45

A taxi charges \$5 plus \$2 per kilometre. Write the cost rule and find the cost of 8 km.

46

A gym charges \$30 to join plus \$12 a month. After how many months does the total reach \$150?

47

Plan A costs \$20 plus \$3 per hour; Plan B costs \$35 plus \$1 per hour. When do they cost the same?

48

A rectangle has perimeter 46 cm and is 4 cm longer than it is wide. Find both sides.

49

A number is doubled, then 7 is subtracted, giving 25. Find the number.

50

Three consecutive integers add to 51. Find them.

51

A phone plan costs \$15 plus \$0.10 per text. Write the rule and find the cost of 240 texts.

52

Explain the difference between the expression $3x + 2$ and the equation $3x + 2 = 11$.

53

A student writes $3x + 2 = 11$, so $3x = 13$. Find and correct the error.

54

A tank starts with 500 L and loses 20 L per hour. Write a rule for the volume and find when it is empty.

SECTION F Indices and quadratic expressions

Add the indices to multiply powers; subtract them to divide.

55 Simplify $x^3 \times x^4$.

56 Simplify $x^8 \div x^3$.

57 Simplify $(x^3)^2$.

58 Evaluate 2^0 .

59 Write 3^{-2} as a fraction.

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

61 Expand $(x - 4)(x + 4)$.

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

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

64 Factorise $x^2 - 25$.

SECTION G Sequences

Find the difference between terms first; a constant difference means a linear rule.

65 Write the next two terms: 4, 7, 10, 13, ...

66 Find the n th term of 4, 7, 10, 13, ...

67 Find the n th term of 5, 9, 13, 17, ...

68 Find the 10th term of the sequence $3n - 2$.

69 Write the next two terms: 2, 6, 18, 54, ...

70

Describe the rule for 100, 90, 80, 70, ...

71

Is 62 a term of the sequence $4n + 2$? Show your working.

72

Write the first four terms of the sequence $n^2 + 1$.

73

Find the n th term of 1, 4, 9, 16, ...

74

A sequence starts at 7 and each term is double the last. Write the first five terms.

SECTION H Coordinate geometry

Sketch the points before you calculate. A diagram catches sign errors.

75

Find the midpoint of (2, 3) and (8, 7).

76

Find the midpoint of (-4, 1) and (6, -5).

77

Find the distance between (0, 0) and (3, 4).

78

Find the distance between (1, 2) and (4, 6).

79

State the gradient of a line parallel to $y = 3x - 2$.

80

State the gradient of a line perpendicular to $y = 3x - 2$.

81

Write the equation of the line through (0, 5) parallel to $y = -2x$.

82

Do (1, 4), (2, 7) and (3, 10) lie on one straight line? Explain.

83

Find where $y = 2x + 6$ crosses the x-axis.

84

A line passes through (2, 5) with gradient 4. Write its equation.

SECTION I Formulae and rearranging

Undo the operations in reverse order, doing the same thing to both sides.

85 Make r the subject of $C = 2\pi r$.

86 Make h the subject of $A = (1/2)bh$.

87 Make x the subject of $y = mx + c$.

88 Find the area of a circle with radius 5 cm, in terms of π .

89 Use $v = u + at$ to find v when $u = 3$, $a = 2$ and $t = 5$.

90 Use the same formula to find a when $v = 20$, $u = 4$ and $t = 8$.

91 Convert 25°C to Fahrenheit using $F = 1.8C + 32$.

92 Make C the subject of $F = 1.8C + 32$.

93 A square has perimeter P . Write a formula for its area in terms of P .

94 Use $A = P(1 + r)^n$ to find the value of \$2,000 at $r = 0.05$ after 2 years.

SECTION J Mixed review and exam-style

Show every line of working; method marks are earned even when the answer slips.

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

96 Solve $x/4 - 1 = 2$.

97 Solve $2x + 3y = 12$ when $x = 3$.

98 Simplify $3(2x - 1) - 2(x - 4)$.

99 Solve the inequality $4 - x > 1$.

100

A rectangle has width w and length $3w$, with perimeter 48 cm. Find w .

101

Two numbers have a sum of 30 and a product of 200. Find them.

102

The n th term of a sequence is $50 - 3n$. Find the first negative term.

103

A trip costs \$12 plus \$0.40 per km. Write the rule and find the distance for a \$28 fare.

104

Explain how to check the solution to a pair of simultaneous equations.

Answer key

Work each section before you check it. These are model answers: an equivalent method, or a different well-supported interpretation, can be just as correct.

SECTION A - EXPRESSIONS AND EXPANDING

1. $6x$.
2. $3a + 8b$.
3. $3x + 12$.
4. $-2x + 10$.
5. $6x + 2$.
6. $3(2x + 5)$.
7. $4(2y - 3)$.
8. 5.
9. 19.
10. $3n + 5$.
11. $3x$.

SECTION B - SOLVING LINEAR EQUATIONS

12. $x = 7$.
13. $x = 6$.
14. $x = 6$.
15. $x = 15$.
16. $x = 3$.
17. $x = 5$.
18. $x = 7$.
19. $x = -7$.
20. $y = 10 - 2x$.
21. $x = (y + 6)/3$.
22. $x = 5$.

SECTION C - STRAIGHT-LINE GRAPHS

23. 2, from $(9 - 3)/(4 - 1)$.
24. -2, from $(-3 - 5)/(2 - (-2))$.
25. Gradient 4 and y-intercept -5.
26. $y = 5$.
27. $x = 4$.
28. $y = 3x - 2$.
29. $y = 3x + 4$.
30. Yes, because $3(2) + 1 = 7$.
31. $y = -2x + 6$.
32. They are parallel, so they never meet.
33. It crosses the y-axis at (0, 3) and the x-axis at (3, 0).

SECTION D - SIMULTANEOUS EQUATIONS AND INEQUALITIES

34. $x = 2, y = 5$.
35. $x = 7, y = 3$.

36. $x = 4, y = 3$.
37. $x = 4, y = 2$.
38. $x = 2, y = 1$.
39. $x < 4$.
40. $x \leq 2$.
41. An open circle at 2, a closed circle at 6 and the line shaded between them.
42. -2, -1, 0, 1 and 2.
43. The inequality sign reverses.
44. 13 and 7.

SECTION E - MODELLING AND REASONING

45. $C = 5 + 2d$; the cost is \$21.
46. 10 months, from $30 + 12m = 150$.
47. After 7.5 hours, when both cost \$42.50.
48. Width 9.5 cm and length 13.5 cm.
49. 16.
50. 16, 17 and 18.
51. $C = 15 + 0.1t$; the cost is \$39.
52. An expression has no equals sign and can be simplified or evaluated; an equation states equality and can be solved.
53. They added 2 instead of subtracting it. $3x = 9$, so $x = 3$.
54. $V = 500 - 20h$; the tank is empty after 25 hours.

SECTION F - INDICES AND QUADRATIC EXPRESSIONS

55. x^7 .
56. x^5 .
57. x^6 .
58. 1.
59. $1/9$.
60. $x^2 + 8x + 15$.
61. $x^2 - 16$.
62. $2x^2 - 5x - 3$.
63. $(x + 2)(x + 5)$.
64. $(x - 5)(x + 5)$.

SECTION G - SEQUENCES

65. 16 and 19.
66. $3n + 1$.
67. $4n + 1$.
68. 28.
69. 162 and 486.
70. Subtract 10 each time; the nth term is $110 - 10n$.

- 71. Yes. $4n + 2 = 62$ gives $n = 15$, a whole number.
- 72. 2, 5, 10 and 17.
- 73. n^2 .
- 74. 7, 14, 28, 56 and 112.

SECTION H - COORDINATE GEOMETRY

- 75. (5, 5).
- 76. (1, -2).
- 77. 5 units.
- 78. 5 units.
- 79. 3.
- 80. $-1/3$.
- 81. $y = -2x + 5$.
- 82. Yes. The gradient between each pair of points is 3.
- 83. (-3, 0).
- 84. $y = 4x - 3$.

SECTION I - FORMULAE AND REARRANGING

- 85. $r = C/(2\pi)$.
- 86. $h = 2A/b$.
- 87. $x = (y - c)/m$.
- 88. $25\pi \text{ cm}^2$.
- 89. 13.
- 90. 2.
- 91. 77°F .
- 92. $C = (F - 32)/1.8$.
- 93. $A = P^2/16$.
- 94. \$2,205.

SECTION J - MIXED REVIEW AND EXAM-STYLE

- 95. $x = 11$.
- 96. $x = 12$.
- 97. $y = 2$.
- 98. $4x + 5$.
- 99. $x < 3$.
- 100. $w = 6 \text{ cm}$.
- 101. 10 and 20.
- 102. The 17th term, which is -1.
- 103. $C = 12 + 0.4d$; the distance is 40 km.
- 104. Substitute both values into both original equations; each must give a true statement.

Review and next steps

Mark your work against the answer key, record your score for each section, then answer the three questions below. Bring this page to your next lesson so your tutor can start from what actually blocked you.

Which question did you find hardest, and what exactly stopped you?

Rewrite the corrected working for that question here.

Which section do you want to practise again before your next lesson?

Score record

SECTION	QUESTIONS	NUMBER CORRECT	PRACTISE AGAIN?
A. Expressions and expanding	11		
B. Solving linear equations	11		
C. Straight-line graphs	11		
D. Simultaneous equations and inequalities	11		
E. Modelling and reasoning	10		
F. Indices and quadratic expressions	10		
G. Sequences	10		
H. Coordinate geometry	10		
I. Formulae and rearranging	10		
J. Mixed review and exam-style	10		
Total	104		

Keep going with one-to-one support.

This is an original Noble Educators topic sample, not a complete syllabus and not an official exam paper. Check the topic, level and any required methods with your school or tutor.

Book a free demo lesson at nobleeducators.com/contact